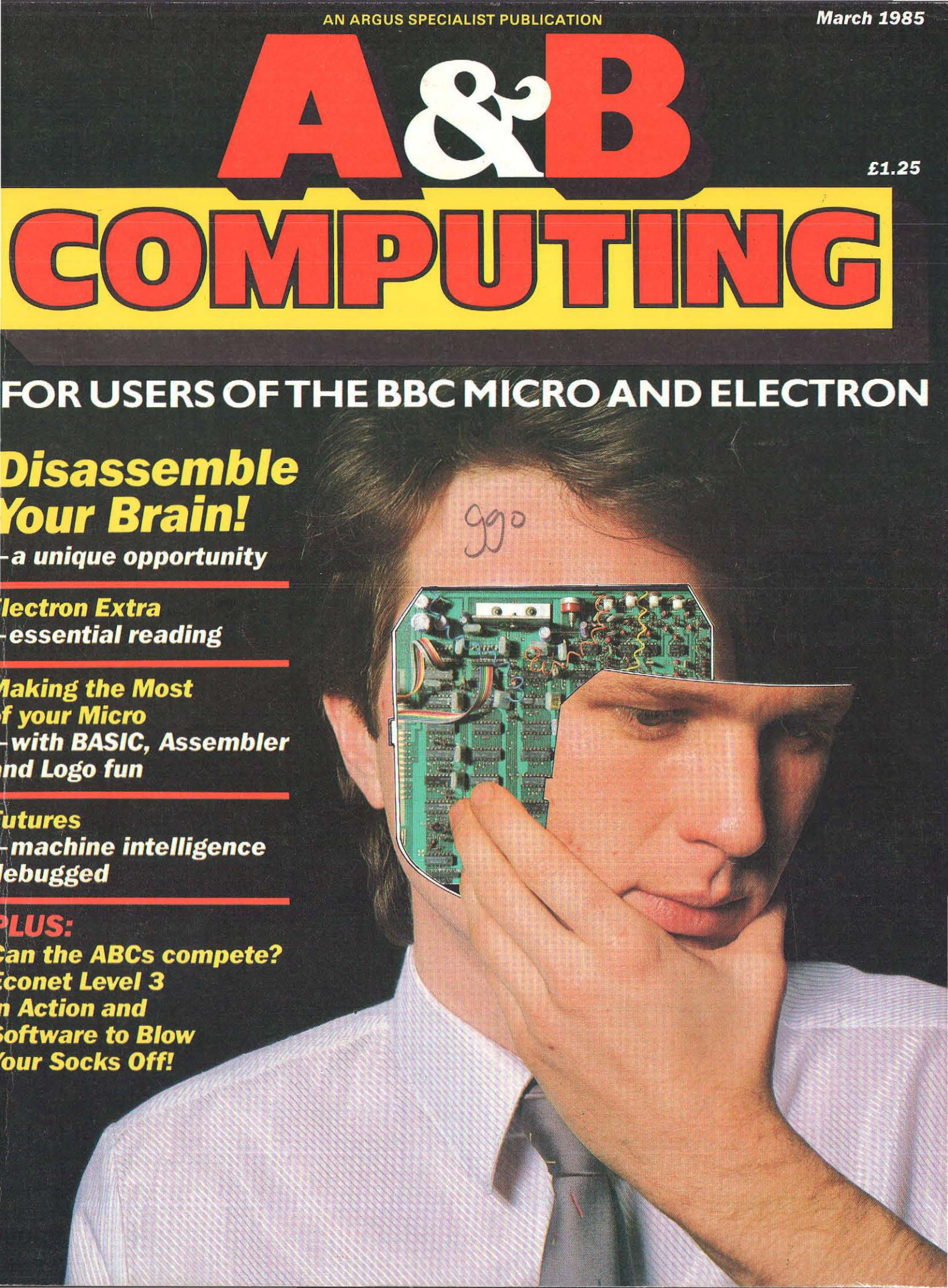
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March 1985

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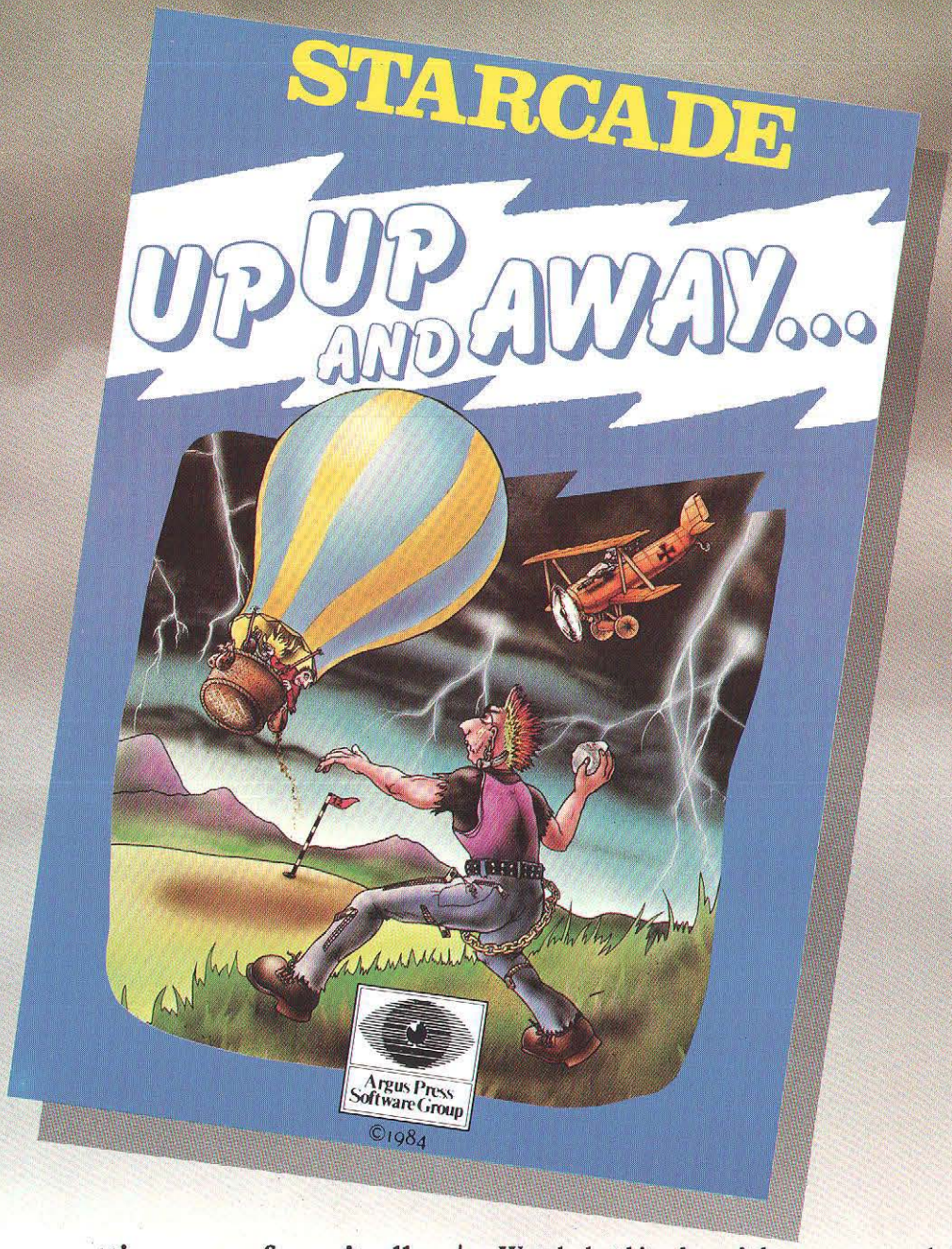
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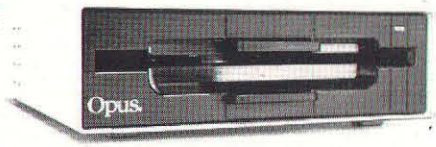
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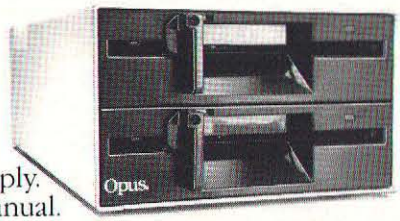
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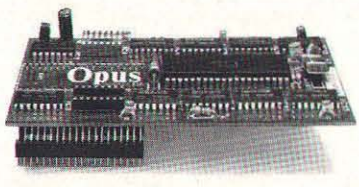
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Volume Two Number

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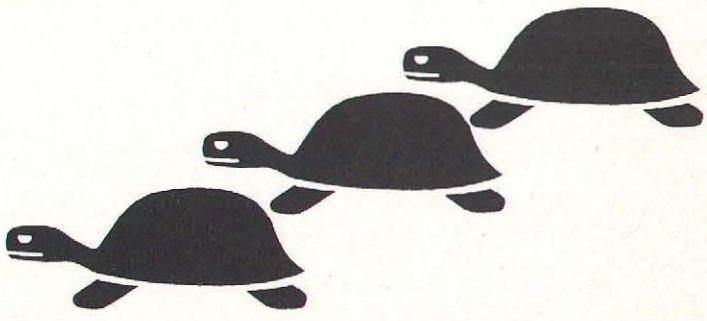
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Is Acornsoft's Logo the definitive version?

A&B Computing is constantly on the look-out for well-written articles and programs for publication. If you feel that your efforts meet our standards, please feel free to submit your work to us for consideration for publication.

All submitted material should be printed or typed, double spaced. Any programs submitted should be listed (55 character width emphasised if possible). A cassette of the program alone will not be considered. All programs must come complete with a full explanation of the operation, and where relevant, the structure. We also require the program in machine readable form (cassette, 40 track 5¼", or 3" disc) plus any suitable screen photographs, printer dumps and so on.

All submissions will be acknowledged and the copyright in such works which will pass to Argus Specialist Publications Limited will be paid for at competitive rates. All work for consideration should be sent to the Editor at our Golden Square address.



News Ne

ROM RETRACTION

A&B Computing wishes to apologise to Wizard Development for an erroneous statement made in the review of the Wizard Joy ROM in our December magazine. Whilst our reviewer states that moving Link 33 to the east enables the user to use a 4K ROM, he also wrongly states that this means that IC100 and IC101 can then only be used with 4K ROMs.

The only ROMs which will not work are the 27128 type as used by the operating system and BASIC. The 8K ROMs such as DFS, Disc Doctor, Wordwise, Gremlin etc will function perfectly. The Wizard Joy ROM will work with ROM boards.

The only games which Wizard Joy ROM cannot convert to joystick operation are those that have been written with the use of the Sheila system workspace. Sorry Wizard. Wizard Joy ROM is available from Wizard Development, 22 Carver Street, Sheffield S1 4FF. Telephone: 0742 752732.

MUSHROOM ROM

A new ROM has been developed by Mushroom Computers to bring a speed and efficiency boost to Econet systems. The plug-in ROM includes a comprehensive commands package which frees user memory for operational tasks.

The ROM, called Net-Nurse, allows the network manager greatly enhanced supervision and control. It provides quicker, easier access, instant data transmission and makes Econet all-party support stands an excellent chance of becoming law.

All pupil records can be stored and accessed including fields for names, addresses, dates of birth, classes, option groups, medical details, examination results etc. The fields are set up by the user and up to five screens of information are available for each pupil.

A security code may be used for restricted access. Sorting can be alphabetic, numeric or in date order and it is possible to include any amount of extra information with the final printout.

There is also the facility to load previously created Wordwise letters for the automatic insertion of the personal details you require, and the program contains a simple wordprocessor for creating letters and lists which can be merged with information from the Search and Sort routines.

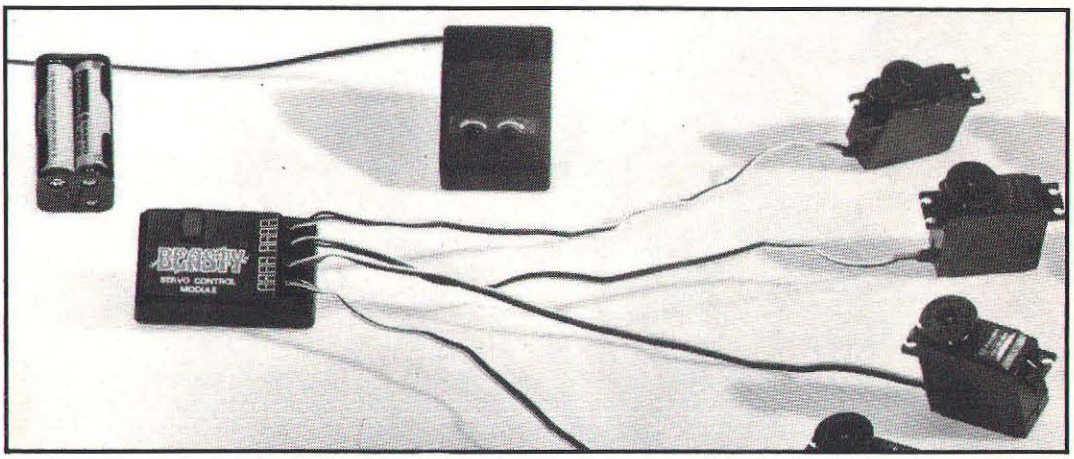
The program is available on 40 or 80 track disc and supplied with a users manual. It costs £39.95 from Toad Educational Computing, 8 Westbourne Grove, Sale, Cheshire M33 1RP.

PRIMARY PROGRAMS

Acornsoft have released a new software range providing home education for the young. Their first four titles are Workshop, Spooky Manor, Talkback and ABC.

The aim of the programs is to "create opportunities for learning, rather than set up exercises with narrow, pre-determined goals," according to Don Clark, head of the company's Home Education Division. "Through them users can explore, experiment, solve problems, even set their own challenges — all essential tasks in real life."

The titles cost £9.95 (cassette) and £11.50 (disc) for the BBC and £9.20 (cassette) for the Electron.



NEWS AT NINE

All six Level 9 adventures, including their latest game Return to Eden, are now available on disc costing £11.95 each.

The discs work with both 40 or 80 track drives, either single or double sided.

If you have a Level 9 adventure on cassette you can exchange it for a disc if you wish. Simply send your cassette plus £2.50 to cover costs to Level 9 at 229 Hughenden Road, High Wycombe, Bucks HP13 5PG.

FAST ACTION

A campaign to strengthen the copyright law for computer software has led to the introduction of a Private Member's Bill by William Powell, a Conservative MP.

The Federation Against Software Theft was establishd last July to initiate the campaign. Its Chairman, Donald MacLean, comments: "A Private Member's Bill strengthening the law on software copyright is a solid step forward in our campaign to fight software theft, which already costs the industry £150 million each year and poses a direct threat to jobs, investment and innovation."

FAST are confident that the non-contentious Bill which has more versatile.

Net-Nurse costs £29.95 and can be used on its own or with Acorn Level One or Two file servers.

Mushroom Computers, part of Broadway Electronics, specialise in networking applications for schools, colleges and industry. Contact them at Aston Road, Bedford, Beds MK42 0LJ.

SCHOOL DATABASE

A random access disc database purpose-designed for use in schools is now available from Toad Educational Computing. The program contains specialised routines not found on general purpose databases.

COMPILATION CASSETTES

Two new compilation packages of games for the BBC and Electron are available from A 'n' F.

Both packs contain Cylon Attack and Chuckie Egg with Haunted Abbey and 180 Darts making up the BBC cassette and Kamikaze and Pharaohs Tomb on the Electron versions.

Three March 1985

Published by Argus Specialist Publications Ltd., Number One, Golden Square, London W1R 3AB. Tel: 01 437 0626.

All work for consideration should be sent to the Editor of A&B Computing at our Golden Square address.

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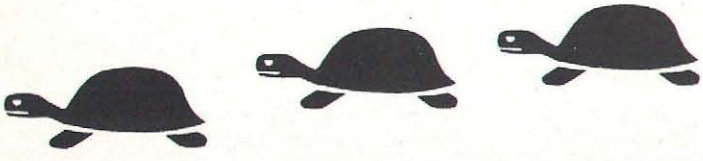
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Want a new program? Check out our guide to what's available for the BBC and Electron.

NEXT MONTH

An issue packed with features on *micros in education*.

- high level networking with hard disc based Econet level 3.
- listings to type in to make learning fun.
- a Mode 7 toolkit to fully exploit Teletext.

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ws News

The packs will retail at £14.95, available from usual distributors.

PRINTER PROBLEM

We have been asked to point out a slight inaccuracy in our review of Tesselations from Cambridge University Press in the Edsoft section of December's issue.

The reviewer stated that the program was not compatible with an Epson FX80 printer but the writers of the software, Homerton College, assure us that it is.

If you are considering buying the program you will be pleased to hear that the package comprising two discs and a handbook now retails for £21.

BEASTY AND THE BEEB

Commotion Ltd have launched the Infra-Red Beasty which they claim to be the first inexpensive, remote control system for home robotics.

This eight-channel interface is available for the BBC as well as other popular computers. It is fully compatible with Commotion's Beasty Arm and Mobile Base and will control up to eight servo motors within a minimum range of six metres. The price has not been confirmed at the time of writing but will be under £50 including manual and software.

Commotion have also published a Robotics Handbook which contains information on all areas of home robotics and a large range of products including arms, turtles, books, speech and vision systems, kits and components.

Contact Commotion at 241 Green Street, Enfield, Middlesex.

BUSINESS DEAL

A comprehensive industry standard insurance service for microcomputer users has been introduced to cover all risks of loss or damage to hardware as well as provide a disaster recovery service which helps towards the cost of reconstituting data files and the added cost of operation.

The service being offered by Insure Data is aimed mainly at the small business user whose business may be totally reliant on his computer system.

Three policies are offered: Bronze, which covers damage to hardware up to a limit of £6000 and offers up to £1000 towards reconstituting files and £1000 towards increased cost of working such as alternative equipment hire. Silver, which provides an additional £500 towards rebuilding files and £1500 for increased cost of working. Finally Gold, which includes a damage indemnity limit of £10,000, £2000 towards reconstructing files and £3000 for increased running costs.

The premium for these policies is £95, £135 and £160 respectively.

For further information contact Insure Data Ltd, 94 High Street, Esher, Surrey KT10 9QJ.

SAFE HOUSE

If you're worried about your BBC or Electron being stolen or used by others you might be interested in Compusafe, a robust lockable computer workstation which can be bolted to the desk top.

Compusafe comprises a 14-gauge steel housing with two sliding shelves which hold the computer/keyboard and associated disc drives. A monitor can also be bolted on to the top of the housing. It is supplied stove enamelled in a textured finish, specially formulated to match either the BBC or Electron.

Compusafe has two separate locks. The first enables the shelves to be pulled out to use the keyboard, disc drives or cassette holder but does not allow them to be removed from the housing. The second allows the shelves to be fully extended in order to remove the computer and peripherals.

The manufacturers, Versapak, keep a computerised key register to enable duplicate keys to be obtained only by authorised persons. Duplicates cannot be cut by local locksmiths.

Compusafe is available for £80 from Versapak International Ltd, 17 Uplands Road, Bexleyheath DA7 4PL.





THE SOFT LIFE

A numeric keypad is available which has been specifically designed to complement the keyboard of the BBC. The keypad, from Softlife, allows speedy entry of numeric data.

Software is provided on Eprom and operation takes up no user RAM. An alternative mode is available which occupies 256 bytes of RAM but allows for full programmability and use on BBCs not fitted with the keypad software.

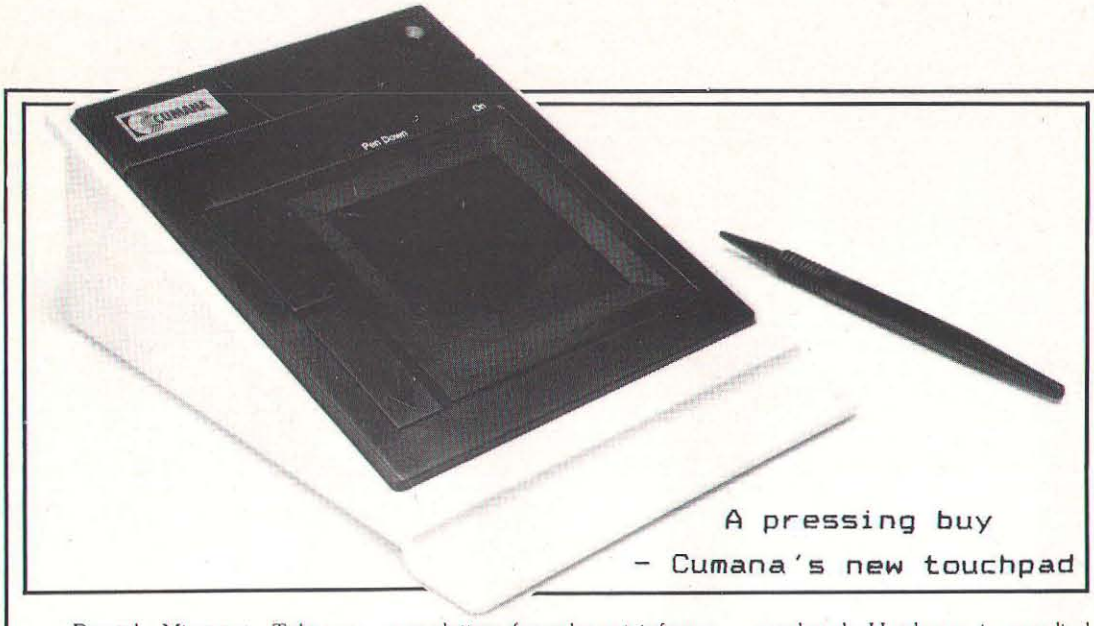
The hardware is manufactured from high quality components and offers full N-key rollover. The keypad plugs into the BBC user port and needs no external power supply.

The keypad is available through mail order for £60.25 inclusive. Write to Softlife Ltd, 7 Rose Crescent, Cambridge CB2 3LL.

UNICOM MODEM

A full facility modem is now available for under £50 from Unicom. The machine features auto dial, auto redial, auto answer, auto band rate scan, full duplex, half duplex, bulletin board facility, number memory store, compatibility with UK, USA and European standards, power supply, leads and manuals.

CONTINUED OVER



A pressing buy
– Cumana's new touchpad

Prestel, Micronet, Telecom Gold, Easylink and Homelink are all held in ROM and up to 99 telephone numbers can be stored on disc.

The modem automatically redials until connected and a remote facility enables owners to dial up their own or other micros to upload or download software.

The software commands can be incorporated into the owner's own programs and an error correction protocol ensures sending, storing and receiving files and programs with no transmission errors.

Unicom Ltd can be contacted at 20 Orange Street, London WC2H 7ED.

INSTANT INFORMATION

Subscribers to Telecom Gold, the office automation service, can now access the daily news service IDB Online for instant information on the computer industry. IDB Online is the first public information service on Telecom Gold and is compiled by VNU Business Publications.

IDB Online is an extension of the printed IDB bulletin which was created three years go. It will be available daily to subscribers who can scan headlines and stories at their own convenience. A keyword facility allows subscribers to search the archived newsletters for relevant information on developments, company profiles, products etc.

Telecom Gold Ltd are at 60-68 St Thomas Street, London SE1 3QU.

BEEB BREAK

A series of weekend breaks for BBC computer enthusiasts is being offered by Micro-Aid in conjunction with the Three Crowns Hotel at Chagford in the heart of Devon.

The aim of the weekend is to help enthusiasts find out more about their computers and how to make the most of them while at the same time relaxing in beautiful surroundings.

Guest experts are invited for the four seminars over a weekend. Hardware is supplied although you may bring your own and there is the opportunity to win £50 worth of software.

The weekend starts at 6pm on Friday and continues until 2pm the following Sunday, with bed, breakfast and evening meals included in the price of £89 for two people sharing a double room. £15 extra is charged if both people wish to attend the seminars. The weekends arranged for 1985 are the third weekend in the months of February, March, April, September, October and November.

For full details contact Micro-Aid, 25 Fore Street, Praze, Camborne, Cornwall (tel: 0209 831274) or the Three Crowns Hotel, Chagford, Devon.

APOLOGIES TO WATFORD ELECTRONICS

We sincerely apologise to Watford Electronics for a remark made in Questions and Answers in our November issue.

In reply to a question about Disc Filing Systems we stated that the Watford DFS was unreliable. This could not be further from the truth and we would not wish to mislead anyone considering purchase of a DFS. The Watford DFS is totally reliable.

It is also recognised that Watford Electronics have done all they can to provide compatibility with the Acorn DFS and that they continuously improve their system to make it work with as many products as possible.

Questions and Answers itself pointed out the fact that the Watford DFS has more features than any of its rivals.

IN BRIEF

- More apologies. In the January issue we told you that Opus would exchange their old double density operating system eprom for the latest version free of charge. In fact they are charging £5 simply to cover costs. Sorry for our error and any resulting confusion.
- Computer Concepts have released a new version of their word processing ROM Wordwise. Look out for our review next month.
- The 1985 Educational Software Fair, supported by the Microelectronics Education Programme, the Independent Schools MicroElectronics Centre and Wiltshire County Council, will be held on 1st and 2nd March at Dauntseys School, West Lavington, Devizes, Wilts between 10am and 6pm. Entry is free for all teaching staff.



AT LAST!

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WORDS & PICTURES These early reading games from CHALKSOFT for 3-7 YEAR OLDS will stimulate interest and assist in recognising words to be found in most learning schemes. BBC only. Normal price £9.95. MEMBERS PRICE £7.95. 40 TRACK DISC £10.95

LOOK SHARP Sharpening the powers of observation is great fun with another offering from MIRRORSOFT, with three programs for the VERY YOUNG and one on the second side to amuse and educate children UP TO THE AGE OF ELEVEN. BBC/Electron — Cassette only. Normal price £7.95. MEMBERS PRICE £6.45

JUNIOR

ANSWER BACK JUNIOR QUIZ This quiz for 6-11 YEAR OLDS from KOSMOS should provide hours of fun whilst teaching general knowledge. Questions are included on a wide range of topics, and can also be made up and included on the program. BBC/Electron — Cassette only. Normal price £9.95. MEMBERS PRICE £8.45

BERT BOOT Squashing insects may not sound the most pleasant way to learn multiplication and division, but this program from HIGHLIGHT SOFTWARE for 8-12 YEAR OLDS really is most enjoyable and rewarding. BBC/Electron — Cassette normally £4.95. MEMBERS PRICE £3.95. 40 TRACK DISC £5.

SENIOR

NOTE INVADERS This program from CHALKSOFT for 7 YEAR OLDS and over provides entertaining practice at learning note recognition on the bass and treble clefs. BBC/Electron — Cassette normally £9.95. MEMBERS PRICE £7.95. 40 TRACK DISC £10.95

ANSWER BACK SENIOR QUIZ As for the junior quiz above, but loaded with more difficult questions to stretch the minds of anyone 11 YEARS OR OLDER. Prices as above

DECIMALS A more serious program from CHALKSOFT, teaching and practicing the principles of the decimal system suitable for 9 TO 15 YEAR OLDS. BBC only — Cassette normally £9.25. MEMBERS PRICE £6.45. 40 TRACK DISC £10.95

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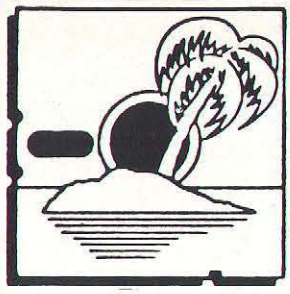
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for the

BBC MICRO

Any BBC user will be aware that entering numeric data on the BBC keyboard, whether for business, educational or scientific purposes, is a slow and inefficient process. The Softlife Numeric Keypad changes all that. Speedy entry of numeric data is now possible — as on many more expensive computers.

Features
- ★ N-Key rollover
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- ★ High quality keys
- ★ Hand held, or free standing
- ★ Software provided on emprom
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VIRGIN BOOKS

ADVENTURE GAMES!

Soft Sector

This month's mix of Marvel heroes, monsters from Eden, manic miners and mysterious castles.

The A&B offices were fairly chock a block with software of all kinds in the month up to Christmas. A rash of games for the BBC and Electron from companies formally associated with other computers and the ever broadening catalogue of Acornsoft titles helped to swell our coffers.

Acornsoft, amid speculation about them publishing for other micros like the CBM 64, came up with nothing as spectacular as Elite but some pretty worthy stuff nonetheless.

Elite incidentally had sold (so the claim went) 50,000 copies by the start of December and Electron Elite had only just started to appear in the shops. Apparently the first copies of Electron Elite sent out from Vector Marketing had notes with them saying that the software might have to be recalled for "repair"!

MINER MANIA

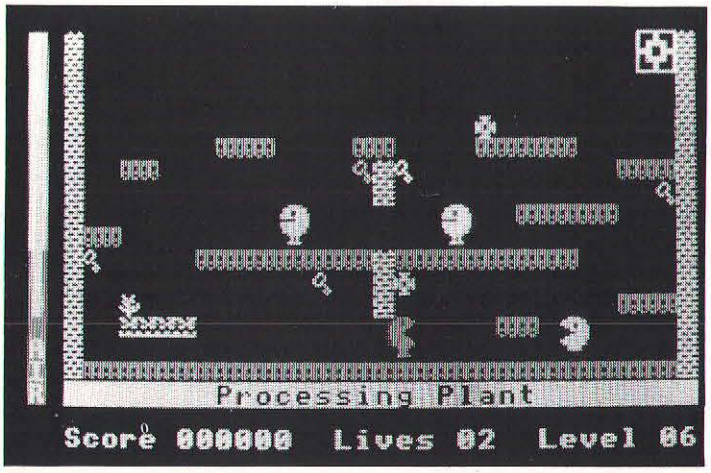
BBC and Electron games players have, I am sure, been aware of the maniac miners who have dominated the screens of others micros last year. We have had some access to this sort of platform game through the likes of Alligata's Blagger and Son of Blagger.

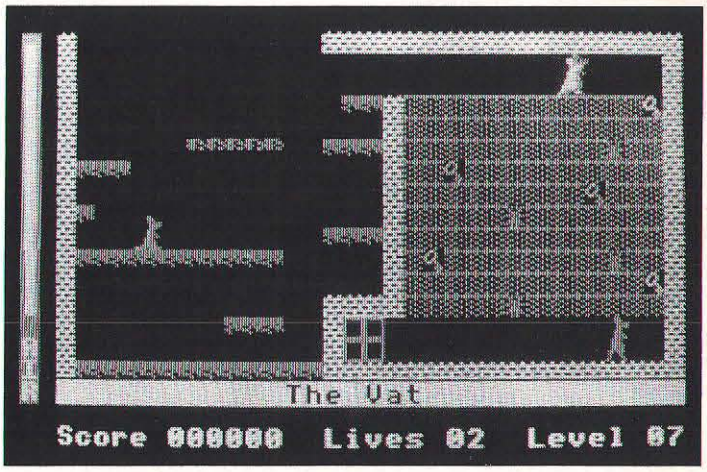
Now the original Manic Miner, from Software Projects, is available for the BBC. So too is a version called Mineshaft from Durell. Take a look at the sort of screens you get with both these games. It's much more difficult than you think with disintegrating sludge, awkward jumps and nasty obstacles to bog you down on every screen. It takes a great deal of imagination as well as considerable dexterity to conquer such games.

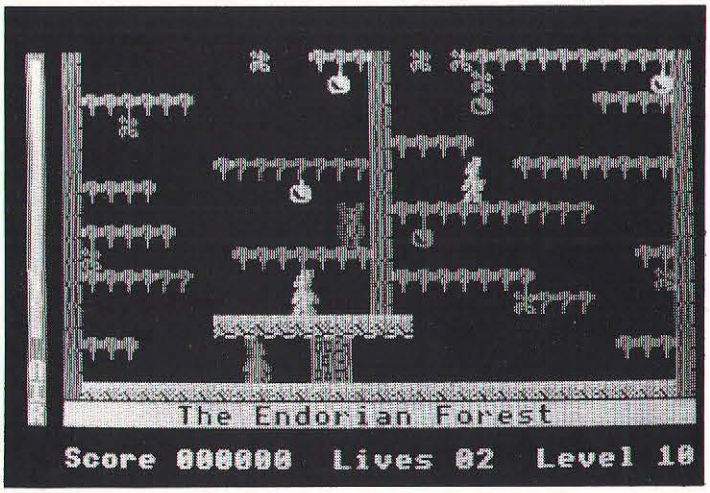
Manic Miner is a bit disappointing from a graphics point of view. Colour has been sacrificed for playability and smooth action. Only the title pages during loading are spectacular! Unfortunately this BBC version lacks much of the "feel" of the Spectrum and Commodore 64 games. It's much more difficult to twist and turn while on the move at critical points of the game.

Despite this Manic Miner is a classic challenge for the game player and there are 20 lethal caverns to try, and only three lives to do it with !

Mineshaft is similarly



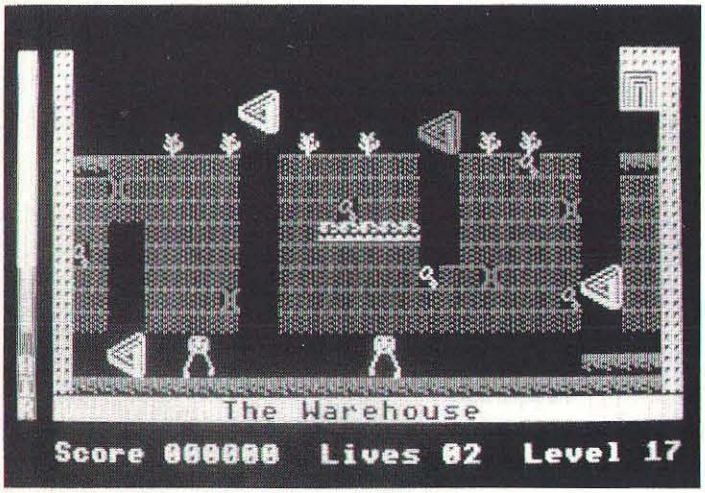














Manic Miner caves

ordinary in the graphics department. Nothing on Blagger for instance and certainly with none of the design skill displayed in a game like Frak! There's the usual three key controls, left, right and jump and some interesting tricks have to be performed to make it through many of the 20 rooms. Of course your character (who isn't a card carrying miner but has dropped in by mistake) has to retrieve lumps of coal, survive the sludge and make it back to the next room before his air runs out.

Mineshaft is great fun if a bit thin as a spectacle. Response is excellent so the skillful will be rewarded for clever play. Impossible to judge between the two, very similar, games. Best to try them out first and see which one presents the best challenge.

MARVELLOUS ADVENTURING

A Marvel-ous time leaping around the comic world of Spiderman awaits the adventurous BBC gamer in Scott-Adams' (such famous names!) collaboration with the creators of Superman, the Hulk and Spidery himself.

A real Marvel comic picks up the thread of Spidey's latest thriller and sets the scene for the micro adventure.

It's a text only adventure and there's a disappointing lack of comic strip language. The game makes up for it by involving arch enemies like Mysterio, Lizard, Sandman and Ringmaster. Madame Web is also in the same skyscraper for consultation and clues.

Spidey gets up to some typically arachnid stunts in lift shafts and into scrapes on the sides of skyscrapers!

His spidy sense and strength come in handy but it's the player's ability to come up with the correct formula which counts.

The screen display is interesting with location, exits and visible objects at the top of the Mode 7 screen and the conversation between player/computer at the bottom.

The computer dialogue gives a nice line in encouragement and sometimes desperation, eg "You can't do that...yet!" and "I must be stupid but I just don't know what you mean."

Spiderman's adventure is just one (number two) in the Questprobe series involving a whole host of superheroes Can you resist?

FANTASTIC

Have you noticed how most of the fantasy adventure games for micros make no attempt to disguise the fantastic element. It is up to the player to immerse him or herself in the creation of the designer/programmer, whether it's the world of a Marvel comic, of goblins and giants, or the ice-cold loneliness of outer space.

In Addison-Wesley's "The Secret of Arendarvon Castle", a mass of pseudo authentic literature absorbs the player into the microworld adventure. The book provides research material for the player (now an investigative journalist) to digest and arrange to help solve the mystery.

There are maps and plans, articles on magic and sorcery (real magic practised by medieval alchemists). There are no goblins, just apparently hard facts, frightening worrying facts about James Douglas, former owner of the castle and creator of a cube containing a huge Magic Force.

The library of Arendarvon Castle is a rich archive of material on the ancient lore, including the magic script, the writing down of magic spells.

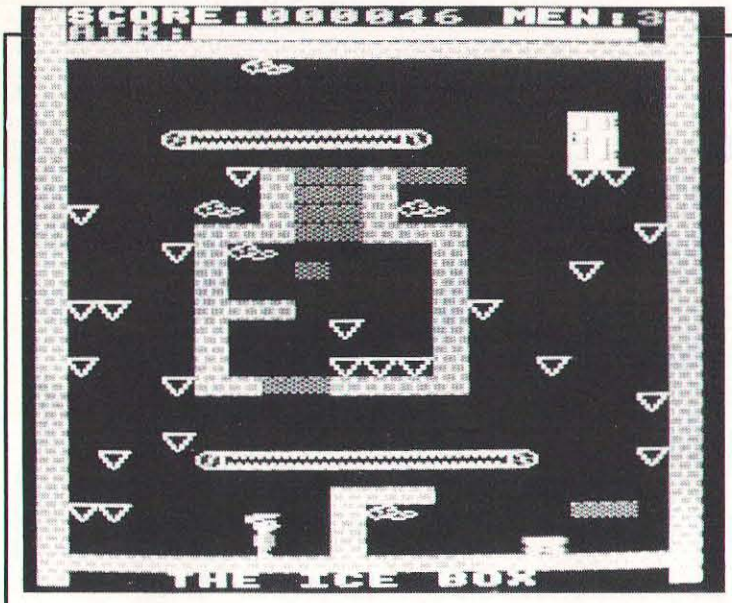
It is impossible not to be caught up in the seemingly disturbing reality. Danger obviously threatens but if the terrible force is not to be unleashed you must find the secret. Ghostbusters? This is for real.

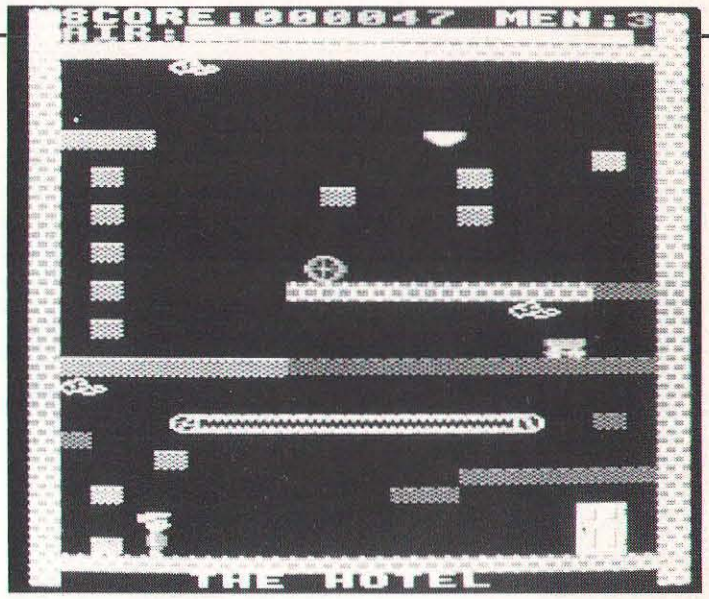
You can buy the book and type in the listing or get lazy and buy the cassette as well. Entering the code from the book won't spoil the fun and it's designed to self-check errors. Bookware is catching on and with this one you get good value, a nicely produced book, some engrossing background and a good program.

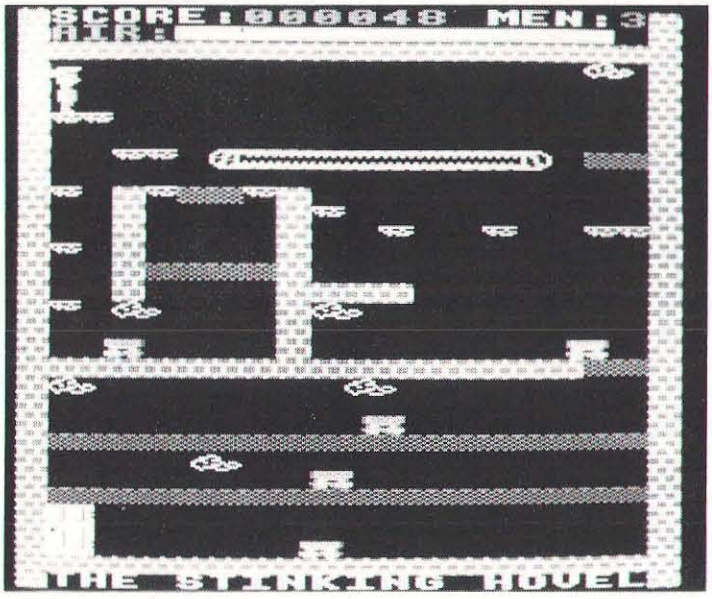
It wasn't long before I was believing in James Douglas, in the astral force he harnessed, the fiend Borazar and the dire necessity to complete this adventure, perhaps with the help of Zazar the Great. A spell will bring him back: "Who is prepared to end the quest, speak this word for mankind's best."

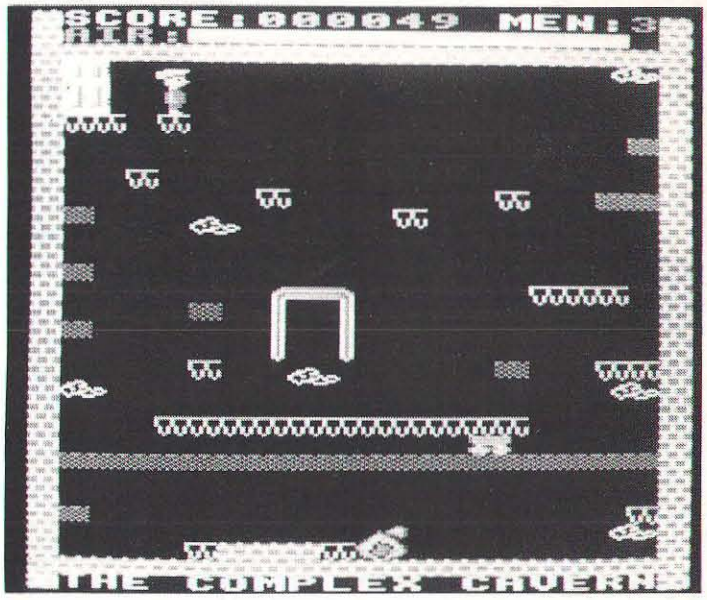
CONTINUED OVER

Mineshaft rooms









It's all to do with believing. Level 9's Return to Eden reinforces the opinion that they, above all, have the ability to manufacture fantasy worlds, characters and storylines for their customers.

Return to Eden continues the story of Kim Kimberley. At the end of Snowball you saved the Snowball 9 transport from destruction but damning evidence to the contrary has forced you to flee in a stratoglider to the planet Eden. Snowball orbits overhead determined to get you before you have had time to reach safety. Enoch, a city built and guarded by robots, is your destination. Things are not as they appear.

This must be one of the most hostile environments an adventurer has ever been pitched into. The acknowledged influences of science fiction classics like Harrison's Deathworld, Aldiss's Hothouse and Asimov's I, Robot might give you a clue to the sort of locations, objects and incidents which are your fate if you choose to play.

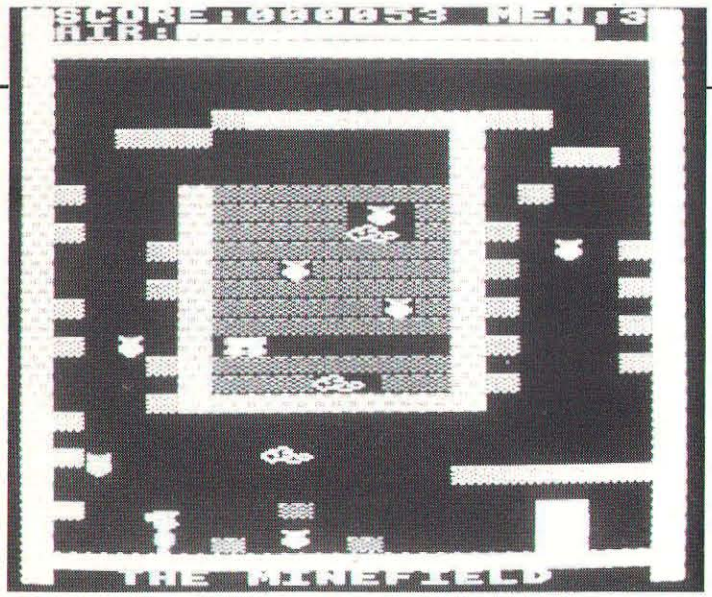
As Kim Kimberley stands in the shattered control room of the glider a whole world, a credible world of some distant future, awaits him.

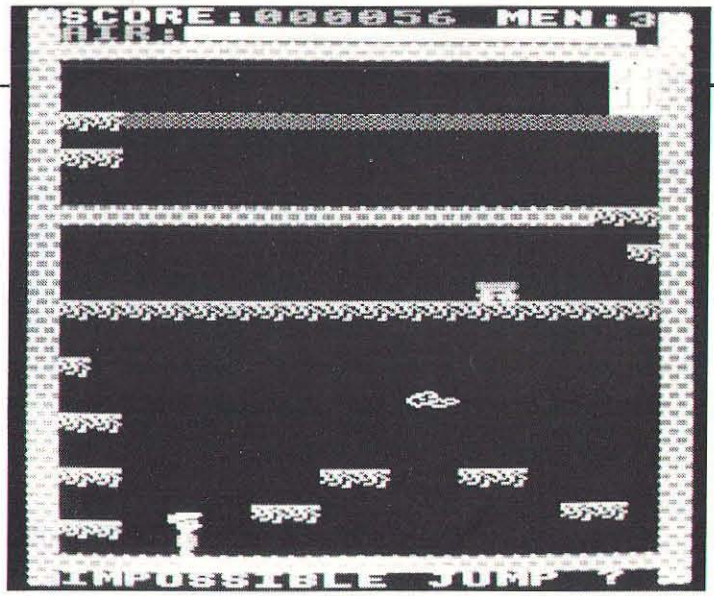
Arendarvon Castle makes the microworld close enough to home to be possible and supplies evidence to back it up. Return to Eden asks for, and gets, your belief in a microworld packed with science fiction props — and it's got a nudist beach!

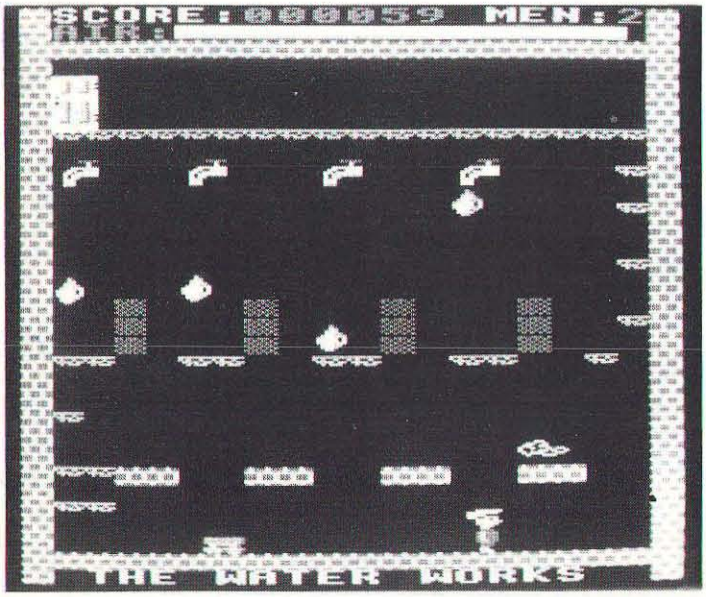
THE RACING GAME

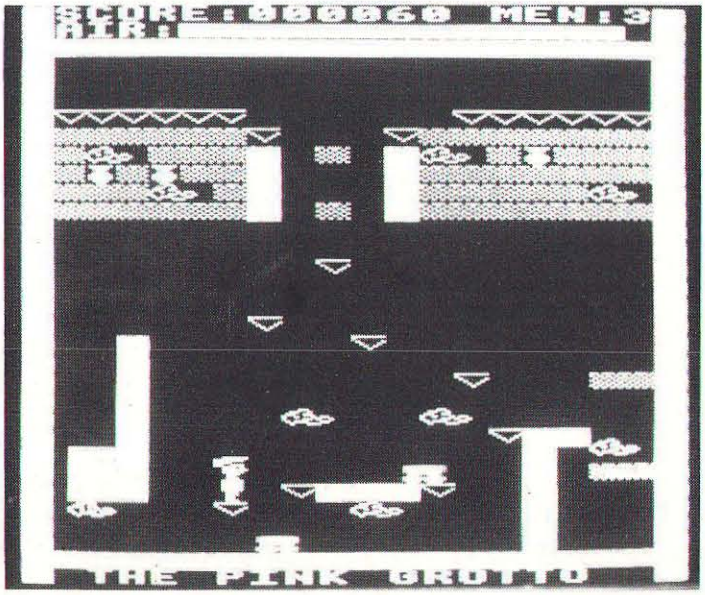
At last Pole Position. The BBC version has been around since the summer and, having played it at the PCW show, the A&B post has been hopefully scanned ever since for the Atarisoft label.

As well as the game you get









a super poster for following the course of the real formula one world championship . . . 1984!

But it's the game that counts. Atarisoft have gone for a Mode 2 copy of the original Atari screen and it's a surprisingly faithful reproduction.

The difference is obvious however as soon as you start racing. The action is not as smooth. The lines of the track break because of the screen resolution. But you do get a five colour car!

Like the original, BBC Pole Position is brilliantly simple. You can play it with one finger if you want. Keys A, S, Return are left, right, brakes. Space bar changes between high and low gears.

Top speed in low is 90, in high 195. Skidding slows you down and so does crashing into other cars! Nice line in explosions, balls of fire sliding off the track accompanied by screeching and smashing sounds.

Function keys are used for start game, keyboard/joystick, sound on/off, freeze game and number of laps.

Pole Postion is the best racing game because it thrills with a real feeling of speed. Skills of judgement and timing are continually tested as cars group on straights and corners, and the seconds are ticking away above. It strips away the frills and concentrates on an exciting games experience. Totally addictive.

GET SET GO

Talking of Ataris . . . an "atari" is a game position in Acornsoft Go. In July/August 1983 *A&B Computing* and Acornsoft held a competition to find the best computer Go in the country. The prizes were presented a year ago and now the winner, Bruno Pryzbyla, has collaborated with Acornsoft to produce a commercial version.

Very playable it is too and a great way to learn — especially since you can get the computer to help you out with the tactics. You can play the computer, a friend or just watch the program fight it out with itself. You can even watch it think and boy does it crunch moves looking ahead at a considerable number of combinations at mind boggling speed. A full appreciation will follow in a future A&B.

HAVE YOU ALREADY GOT DISK DRIVE(S) FOR YOUR BBC COMPUTER?

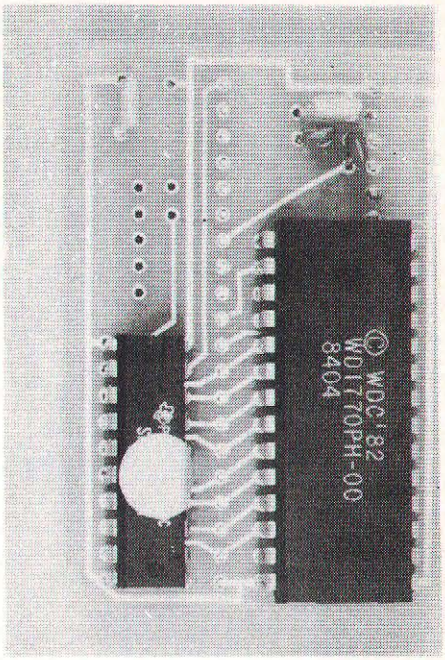
SOLIDISK HAS SOMETHING TO OFFER.

— FOR THOSE OF YOU WHO DO HAVE ALREADY, A DUAL FDC DISK FILING SYSTEM (DFDC, using the old 8271 and adding the new WD1770 FDC), ADDS DOUBLE DENSITY AND KEEPS TOTAL COMPATIBILITY (See opposite page).

— FOR THOSE WHO HAVEN'T, A DUAL DENSITY DISK FILING SYSTEM (using the new WD 1770) WILL PROVE MUCH FASTER AND CHEAPER THAN THE 8271.

THE DISK DRIVE:

The disk drive (see pictures) comes from the new series VLSI ultra quiet, auto spin-up, 5.25" half height, solenoid head load, 40/80 track, single and double density MITSUBISHI M4853. It is fast, quiet and consumes far less power than any previous models. 2 new 64 pin surface mounted microcontrollers (from Motorola and Mitsubishi), largely reduce the area occupied by the drive electronics (see pictures), leaving so much more room for the diskette, with very low noise level and reduced friction of the media and the jacket.



SOLIDISK DUAL DENSITY DISK FILING SYSTEM.

Basic characteristics include very high operating speed, Acorn compatibility, automatic 40/80 track switching, auto-density, resident disk formatter and 100% compatibility with Solidisk Sideways RAM.
It is also the simplest ever Disk Upgrade for the BBC computer: with only 4 components: 1 ROM, 2 buffers and the FDC. (See picture 3).

Solidisk software engineers have built in to the 8192 bytes of the 1.40 ROM more facilities than any other DDFS manufacturer has managed before.
The result is a substantial cost reduction, which is passed on to you.
Solidisk engineers won't stop there.
But let's first answer some more immediate questions.

1 — SINGLE OR DOUBLE DENSITY?

You get 60% more storage in double density mode than in single density mode at no extra cost.

In single density — the usual Acorn disk format — you get 10 sectors or 2.5 k bytes of storage per track. That is what the Acorn DFS and many others can do.
In other words, you get 100k with a 40 track single sided disk drive (such as the TEAC 55A), 400k with a double sided 80 tracks disk drive (such as the one in this offer).
In double density, you get 16 sectors or 4k bytes per tracks, an increase of 60%.
With the same TEAC 55A disk drive, you get 160k instead of 100k or with the disk drive in this offer, you get 640k bytes instead of 400k.

The majority of software tested also runs FASTER in double density mode than in single density mode, especially Wordwise, View, Masterfile and Scribe and 95% + of games are also compatible with double density.

2 — INSTALLATION:

As the STL DFS consists of only 4 ICs, to be plugged into existing sockets on the BBC computer board, installation is quite simple and should not take more than a few minutes even if you are a novice. Simply instal the 4 ICs into their sockets and connect the disk drive (see picture 4).

3 — BASIC DISK SYSTEM COMMANDS AND UTILITIES:

- *ACCESS <afsp> (optional L)
- *BACKUP Ωsource drive> <dest. drive>
- *COMPACT (optional <drive>)
- *COPY <source drive> <dest. drive> <afsp>
- *DELETE <fsp>
- *DIR (<dir>)
- *DRIVE (optional <drive>)
- *ENABLE
- *F40 (optional <drive>)
- *F80 (optional <drive>)
- *INFO <afsp>
- *LIB (optional <dir>)
- *LOAD <fsp> (optional <load address>)
- *RENAME <old name> <new name>
- *SAVE <fsp> <start> <end> <exec>
- *TITLE <title>
- *VERIFY (<optional <drive>)
- *WIPE <afsp>
- *BUILD <fsp>
- *DISC
- *DUMP <fsp>
- *LIST <fsp>
- *TYPE <fsp>
- *DDFS

THE SPECIAL PACKAGE DEAL:

A COMPLETE 640K DISK OUTFIT AT ONLY £209.95 INCLUSIVE:
— ONE 80 TRACK DOUBLE SIDED DISK DRIVE.
— ONE DOUBLE DENSITY DISK INTERFACE.
— ALL LEADS AND MANUAL.
— WORD PROCESSOR.
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— DATABASE.
— STOCK CONTROL.
— MACRO BASIC.
— FULL ONE YEAR NO QUIBBLE WARRANTY.

Optional extra:
— DFDC instead of DDFS: £10.00.

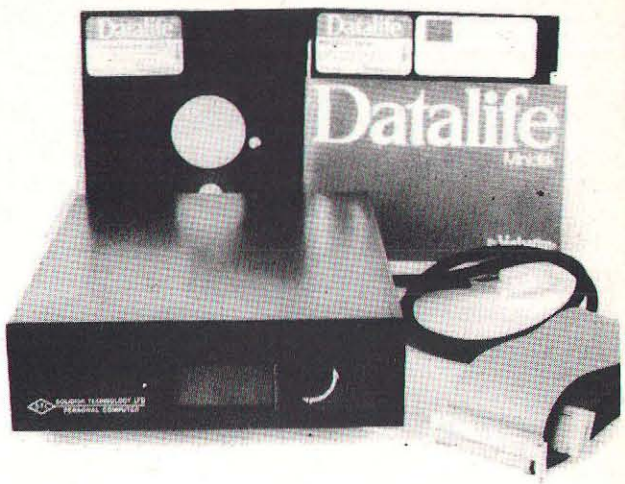
Other OS commands include LOAD, SAVE, BPUT, BGET, OSFILE, BLOCK GET, BLOCK PUT OSARGS, OSFIND, PTR, OSWORD 7F, 7D, 7E etc.

Care is taken in the disk directory presentation, showing the disk size and other useful information. Whenever a diskette is being spun, its number of tracks and density are identified. This information helps the DFS to skip alternate tracks if a 40 track disk is in use in an 80 track drive and also switch the FDC to single or double density.
The net result is exceptional response and user-friendliness.
Outstanding speed too.
As shown in the benchmark test on the opposite page.

CUT THE COST OF RUNNING YOUR MACHINE

Solidisk DDFS comes with free bundled software: (see picture 5).

— Solidisk Database — a fast, efficient and flexible disk based random access database. Ideal for prescription records, club membership etc.
— Solidisk wordprocessor.
— Solicalc electronic spreadsheet.
— Stock Control — very useful for small commerce. Features include menu driven, easy to follow operating instructions, stock items can be grouped by categories, by suppliers, by frequency of movements etc. Stock valuation report (inventory), sale price list, reorder forms can be printed automatically as requested.
— Silexicon — the most successful spelling checker with English, French and German dictionary. Self dictionary generating capability.
— Macro Basic — a BASIC program generator capable of using bits of old programs to create new programs. Simply ingenious!
— Benchmark for disk drive and disk utilities.



4 — OUTSTANDING PERFORMANCE:

The table below shows the benchmark timing for STL DDFS 1.4. The benchmark consists of disk operations such as save and load a 16k program, open and close files, BPUT, BGET strings and numbers, format and verify a disk etc., and is available upon request, otherwise listed in Solidisk DDFS User Manual.
The benchmark tests B1 to B9 are the same as used by many reviewers. The time is expressed in seconds and parts of 100th of a second. The disk drives are twin 40/80 track double sided MITSUBISHI M4853, the diskettes are Verbatim Datalife MD 557 series, 96 TPI, double density, double sided, pre-verified to ensure that the media is free of all error and mechanical defects and containing solely the benchmark program. The test is loaded into memory, the drive motors are allowed to stop completely 2 seconds between tests, 10 timing samples are taken and the mean time is calculated automatically.
For example:

```
100 DEFFNb1:REM Save a 16k program.
110 T% = TIME
120 *SAVE A 8000 +4000
130 = TIME - T%
```

Full listings are included in the User Manual.
This FN is called 10 times with 3 sec. interval, the mean result is printed as 'B1'.

BENCHMARK DESCRIPTION	S/D TIME	D/D TIME	
B1 Save 16k	**2.62**	**1.43**	
B2 Load 16k	**2.45**	**1.23**	
B3 Openin and close 100 times	**20.70**	**20.16**	***See note 1**
B4 Openout and print 1000 numbers (255)	**5.84**	**4.66**	
B5 Openin and input 1000 numbers (255)	**4.72**	**4.14**	
B6 Openout and print 100 80 bytes strings	**6.18**	**4.91**	
B7 Openin and input 100 80 bytes strings	**4.90**	**4.31**	
B8 BPUT 100 bytes (255)	**3.01**	**2.06**	
B9 BGET 1000 bytes (255)	**1.88**	**1.52**	

Note 1: Whenever a file is to be opened, STL DDFS automatically refreshes the disk directory, thus preventing erroneous disk change. Many other DFS's do not take the same care, although yielding a much shorter time, and this could accidentally stop the program.

OPERATIONS	S/D TIME	D/D TIME
FORMAT 40 TRACKS:	**17.74**	**17.74**
FORMAT 80 TRACKS:	**33.22**	**33.22**
VERIFY 40 TRACKS:	**9.30**	**9.30**
VERIFY 80 TRACKS:	**17.84**	**17.84**
BACKUP 01 80 TRACKS:	**37.69**	**37.69**
BACKUP 02 80 TRACKS:	**39.46**	**39.46**
COMPACT 100K-10 FILES	**22.42**	**18.82**

With Wordwise:
Load 2000 words (17811 bytes) 16.80 sec. (41.40 sec. with AC.
With Scribe:
Count 2000 words (17811 bytes) 4.20 sec. (9.80 sec. with AC .90 DFS)
With Beebug's Masterfile:
Sort records 1 to 20 in PEOPLE sample database, the database is presorted on field 2 then the program is asked to sort on field 1, the time is then taken: 56.23 sec. (127.86 sec. with AC.90 DFS).
These timings are improved even further in double density mode.

The figures speak for themselves.

STL DDFS dramatically increases the operating speed of your software, including wordprocessors like Wordwise, View, Scribe, databases like Masterfile, Starbase etc.

Solidisk engineers won't stop there.

ONE ROM TO RULE THEM ALL

Already a super mini floppy (2.4 MB) and controller for under £400, a 10MB integrated Winchester hard disk for under £600 AND AN EVEN MORE POWERFUL 16K ROM (2.0 UPGRADE) with outlined specifications below are planned for Christmas.

— Unlimited number of entries into the disk directory.
— File size and disk size can be as big as 16MB.
— Immediate recovery of accidental file deletion.
— Built-in wordprocessor in place of the classical *BUILD.
— Disk sector editor, disk search and replace, tape to disk, disk to memory below PAGE, disk duplication.
— Instant data encryption and decryption using 256 byte single key (expandable).
— Quadruple FDC drivers (8271, 8272, WD 1770, WD 2793).
— RAM Disk facilities for Solidisk Sideways RAM.

6 — SOLIDISK DFDC:

THE ONLY SYSTEM TO ADD DOUBLE DENSITY AND KEEP COMPATIBILITY.
If your BBC is already fitted with Acorn Single Density DFS, you can ADD double density to your system and KEEP the existing DFS with Solidisk DUAL FDC Filing System (DFDC).
Solidisk DFDC system overcomes the problems caused by around 5% of the games 'specially those produced by Acornsoft newest releases such as Elite). These programs (directly) controls the 8271 thus requiring its presence.
Solidisk DFDC ROM controls BOTH FDC at a flick of a switch, you can choose the new FDC for speed or the old 8271 for Acornsoft game disks.

7 — PRICES (including P and P and VAT)

STL DDFS (disk chip upgrade for BBC B) £39.95
STL DFDC for those who have Acorn DFS £49.95
640k DISK OUTFIT (complete package) £209.95
1.3MB DISK OUTFIT (with twin drives) £359.95
2.0 ROM Upgrade (available soon) £10.00

To order, you can use the coupon. Access and Barclaycard holders can ring direct:

HOW TO ORDER?

You can order any item using the coupon. Prices are inclusive of VAT, post and packing. Access and Barclay card holders can place their order by phone.
Educational authorities, Acorn dealers and OEMs can obtain quantity discounts.

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SOLIDISK'S NEW TELEPHONE NUMBER: SOUTHEND (0702) 354674 (10 lines)

Disassemble

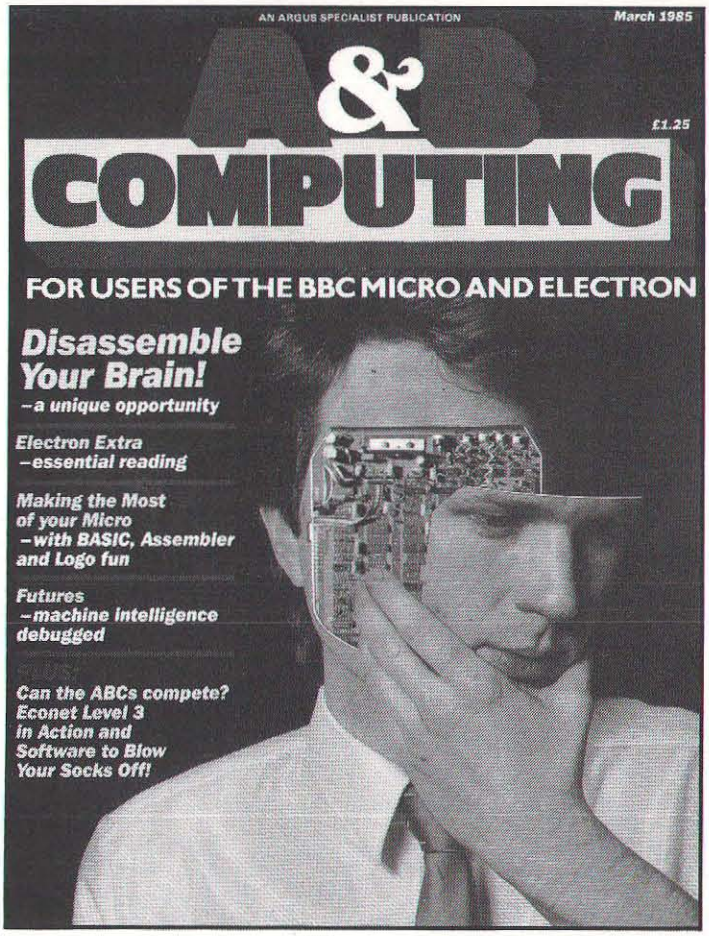
J G van Dijk

This fascinating program from a professional neurologist attempts to delve into the workings of your brain.

How would you like to combine the power of the BBC micro with a faster and ultimately more powerful processor whose memory capacity is so large that you can't measure its capacity in megabytes, for the same reason you can't measure the capacity of your BBC in mere bits — the numbers get too large to handle with ease!?

Yet you possess just such a processor in your head. Even while you are reading this it is busy with a multi-tasked set of routines, subroutines and procedures that luckily you do not have to keep track of. Your built-in operating system does it all for you — it keeps you upright in your seat, makes you eyes follow the lines of this article, uses the processed visual stimuli in collaboration with your memory to give meaning to the text you are reading and does a number of other chores. For instance, it filters what is happening around you so you only have to give attention to conversations between other people when your own name crops up. It would be interesting to know just how the brain does all these things, but I do not know the answers and this article can't deal with questions of such magnitude anyway.

What the article and program will do is to let you have a look at how your brain handles one simple and distinct task. Hence the title of the article; not a gory flesh and blood disassembly of your brain but only a look at the procedures the brain uses while running one of its "programs".



MOTOR PROGRAM

The program we will have a look at is one that you have already used many times when zapping any aliens in sight. You probably used a joystick to move something on the screen, be it a spaceship, a tank or whatever. To be able to allow you to let another alien bite the dust, your brain makes your eyes look at the screen and pinpoint objects of interest.

For example, suppose you had to move a ship (or whatever). The brain judges the distance on the screen that has to be moved and from this calculates the position your fingers ought to be in to move the joystick to move the object to its desired position. It then takes into account the position they are already in and finally comes up with a so-called "motor program". This is a set of instructions for the muscles in your arm telling them how fast and how hard to move, and in what order. It also tells other muscles to relax, so that the arm won't end up as a cramped mass of muscles. It may also make you move to the edge of your chair and make your heart beat faster. Then the motor program is transmitted to the motor pathways going to the arm, but what happens outside the brain is not our concern.

As you can see, the process of merely moving a joystick is not as simple as it might appear to be at first glance. Note that all the steps in this "program" are really enormously complex procedures in their own right. If you are still convinced that moving a joystick is a simple thing to do, you are right, but you are probably thinking of running the program and not devising it.

The same applies for computers — it is easier to play a game of Space Invaders than it is to program one. Disassembling a program, i.e. having a look at how it works, is a tricky business at best, but it is a lot easier with a microcomputer than with the brain. You know the possible instructions the Machine Operating System (knows as the MOS) uses, but you haven't got any notion of how the Brain's Operational System Software (let's call it the BOSS) works.

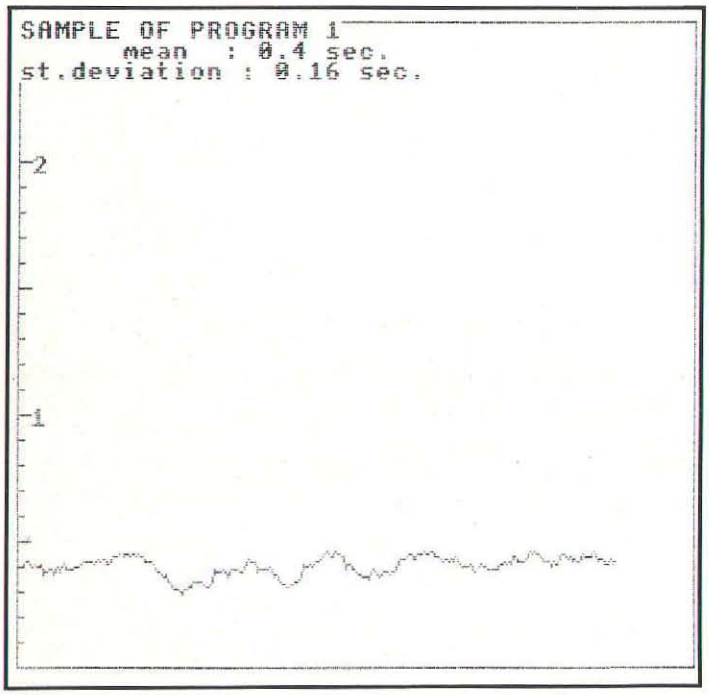
BLASTING ALIENS

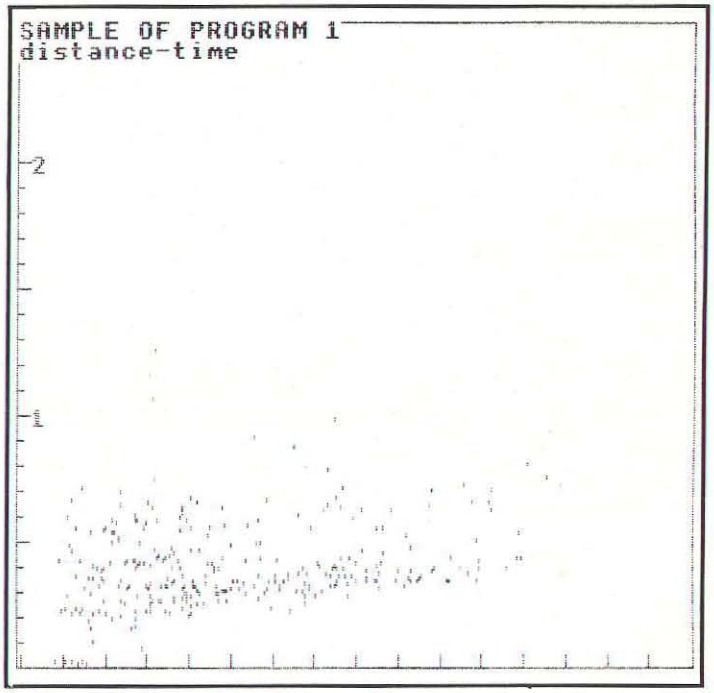
A relatively simple microcomputer such as the BBC can be used to look at the BOSS at work. The task I want you to execute should give you some insight in what your brain is doing, even while you are doing nothing more useful than blasting aliens.

The programs will shed light on, among other questions, does your brain keep track of a moving alien all the time? Is it capable of continuously keeping check of all your movements, or does it only do so from time to time? How does it learn to zap them quicker each time? One way of improving your score might be to remember frequently used motor programs so that they will not have to be calculated each time. A different solution would be to calculate the motor programs more accurately instead of storing them as a whole. Maybe both processes are going on at the same time.

Type in program one and prepare yourself to meet the

your brain





BOSS. It uses a printer dump routine for an Epson printer (copied from **A&B**), which isn't obligatory. If you haven't got a printer skip lines 450 to 560.

PROGRAM 1

Program 1 asks you for a label. This is meant to print the number of the attempt, or the name of the person tested, on the screen for later reference. Use the right joystick. Press the fire button and a small square will appear at the top of the screen, as well as a line starting from the centre. The other end of the line may be moved using the joystick. Try to move the line into the square. The line will stop moving and you will hear a "beep". Press the fire button again for the next try. The variable SOM% in line 20 holds the number of attempts, alter it if you wish. When you are through, the computer will draw a wavy line (PROCmean).

Each point of this line is the mean time for 20 successive tries in order to filter out unusually high or low values. If the line is descending as a whole, you are learning to do it better. At the top of the screen, you will see the mean value for all attempts, as well as the standard deviation (PROCnumber). This last value indicates whether there is a lot of variation in the recorded times — a small value means all times were close to the mean, a large one that you were sometimes a lot faster and sometimes a lot slower. If you now press "D" the printer will dump the screen. (It does not matter which key you press, if you skipped lines 450-560). Now the computer will draw a cloud of points (PROCdist).

Each point is the result of one attempt: the distance is given horizontally, the time vertically. Look closely at the cloud. You will probably see that there is no strong correlation between time and distance. The fastest attempts for the long distances are only fractionally longer than those for the short distances. This shows that the calculations made by the brain for a short distance take no longer than those for a long one.

That's one result already. Once again, you can press "D" for a dump. Run the program a few times until you are satisfied that you are not getting better each time. I seem to have stopped at 0.4 sec, but have never been good at Space Invaders.

LAYERED CLOUDS

Now look at the cloud of points again. Very likely, you will see that it in fact consists of two layers of cloud. One, made up of fewer points, will be at about double the height of the other. This is interesting. The second layer probably reflects the fact that sometimes you only succeeded in touching the square after repeated corrections. If your brain had constantly checked the position of the line and corrected it, you would have got a homogenous cloud, not a layered one. I think the layered aspect means that the brain comes up with a fast motor program, runs it, and only checks the result after it has been carried out. If the result is a failure, a second program is made and executed, etc. When you get better, you probably succeed in getting it right in one go more often so you lose the second layer.

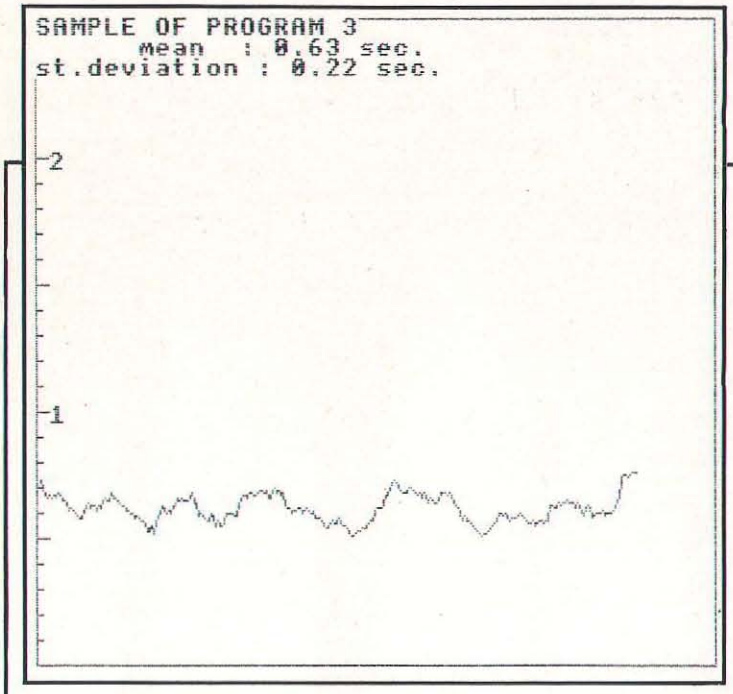
Does the brain handle horizontal movements as well as vertical or combined ones? Make the changes to program 1 as indicated in program 2 (after saving program 1, if you like), and find out. This time, you are required to make vertical movements. I leave the execution and interpretation to you. (I, for one, am equally fast — or slow — in both directions.)

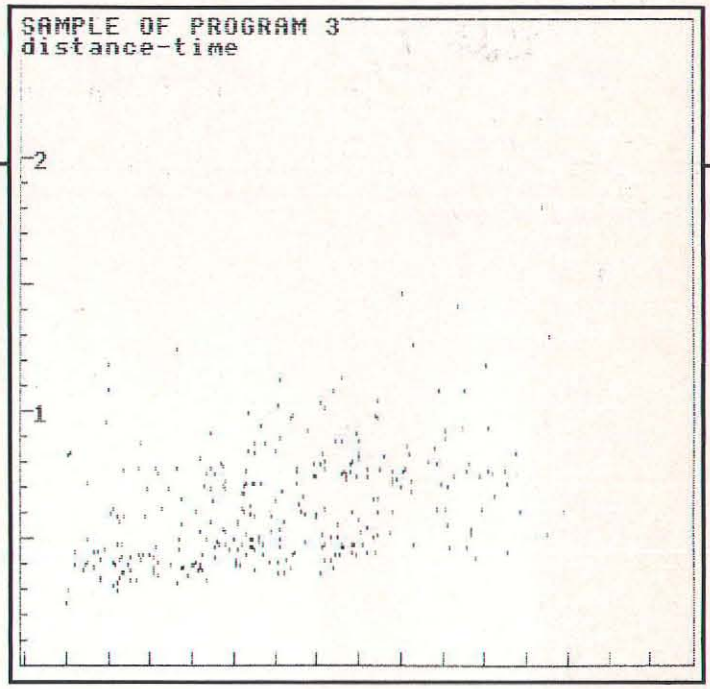
As a further suggestion, try both programs with your "wrong hand". Of course the results are worse, but is this due to a larger number of movements needed to touch the square, or is each motor program executed more slowly? In the first case, the layers will be as high as with your good hand, but there will be more layers. In the second case, the layers themselves will be higher than previously. As you can see there is ample scope for experimentation with your brain, even with a program as simple as this one.

PROGRAM 3

As you probably expected, program 3 combines 1 and 2 (it is not called 3 for nothing). Now try to capture the square wherever it appears at any point on the screen. Run this program just like

CONTINUED OVER





the previous ones, and see what you get. What I expect is that you will now be noticeably slower, but that you will still be able to distinguish layers in the clouds. Just why were you slower? (If some of you were not slower you have got an interesting type of brain, but you should then try to disassemble it yourselves.) Somehow the motor program seems not to be running as quickly as it did before.

There are several possibilities to explain this — either calculating a combined movement takes longer, or it takes longer to execute, or we have introduced a source of error that was not in the program before. The last explanation is probably true. When moving either horizontally or vertically we also moved the joystick in the other direction, which is a source of error, but this was not noticed by the computer. It is now, however. If you like, you can think of programs to prove this (it should be possible).

The fact that there are distinct layers has interesting implications. One is, as stated before, that the brain makes a motor program, and looks at the results when it is executed. Before the moving line moves into the square, two processes take place: firstly, the motor program is calculated, and secondly it is executed. This execution — the movement proper — takes up a bit of time as well. Until now, we have looked at the time taken by both processes together. Let's make distinction now.

PROGRAM 4

Program 4 modifies program 1, not program 3, so be sure to load program 1 first. You will be asked to make horizontal movements again, but after each try a strange little graph will appear at the bottom of the screen. This graph shows time horizontally and the movement itself vertically. The beginning of the graph starts at the instant the new square appears on the screen. A movement upwards means you moved your line to the right, one downwards the opposite. The further the graph reaches across the screen, the longer it took you to touch the square.

Experiment until you have an idea of how the graph functions. Then try to touch the square as quickly as possible. The command graphs will look like a tree on its side. Most graphs will start with a horizontal section, after which they either go up or down. Many end here, but some then have another horizontal section, again followed by movement up or downwards. A horizontal section means that you didn't move the joystick at some time. During this time your brain calculated the motor program. The other sections represent the time taken by the movement itself. Graphs having one "thinking" and one "moving" section represent the attempts of the first layer in the previous graphs. Those with more than one "thinking" section are equivalent to the higher layers. Now the strength of the "thinking " layer represents the time taken by the brain to develop the motor program (and the time needed to transform this in movement of the joystick).

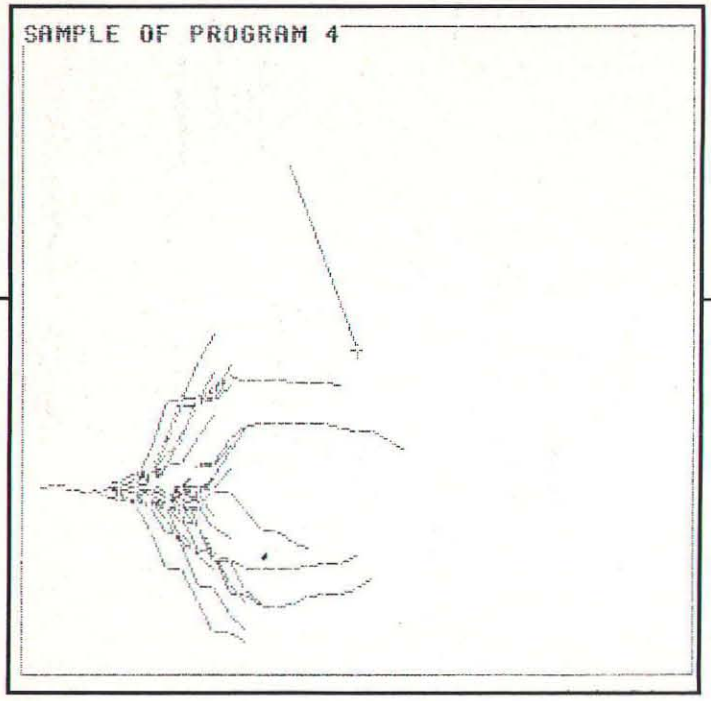
Each point of the curve represents one cycle of the REPEAT-UNTIL process. By building in a time counter you can time the mean length of a cycle. Try this out for yourself, maybe a different MOS — mine is a 1.2 — does it quicker or slower. On my computer, one cycle takes 3.5 hundredths of a second. You can easily count the number of cycles in a given segment — different cycles are separated by one blank pixel. My "thinking" sections take about seven cycles, so the entire section takes about one quarter of a second. In the same manner you can calculate the time taken by the movement itself, it lies probably around one fifth of a second. As you will understand by now, these times are more or less fixed for every person.

No matter how hard you try, there is a minimum time you brain will take to do the task. Most games get faster and faster as your skill progresses. Computers can move an object on the screen faster than you can come up with the motor answer, so that sooner or later you are bound to lose. There are several reasons why the computer is faster. It is built in a different manner but, and this is important, the job the brain is doing is infinitely more complex.

BRAIN POWER

I hope these programs have set you thinking, not only about how computers do their jobs, but also how your brain handles the chores it is presented with. There is a lot of room for elaboration along these lines.

For instance, you might like to test your reaction time in a program and calculate the time it takes your brain to realise that something new is happening, and that it is supposed to do something about it. You could use a randomly generated amount of time after pressing the fire button before a new square is shown on the screen. If you then measure the horizontal section, it will also consist of a "surprise" section. Subtract the value you have just calculated for the "thinking" section and you will then know just how long it takes to be surprised by the sudden appearance of an alien monster. It might come in handy.



PROGRAM DETAILS

10-70	initialisation
90-270	main loop, in which H% holds the number of attempts up to SOM%
100-150	pick new coordinates (X%,Y%) for the square and give NOW a value
160-220	erase previous line (to A%,B%). Find joystick values (C%,D%) and draw a line to them. Change old values to new ones. Stop when line is in square
230-250	SC%(H%) holds time needed to move into square calculated from NOW. AF%(H%) holds distance from starting point (K%,L%) to target (X%,Y%). Calculation uses Pythagorean method. Afterwards store target values in K%,L% — they serve as starting place for next try. Make a beep
260	press fire button for next try
270	various "undrawing', NEXT gives next H
290-300,320	call procedures
310,330	if wanted dump screen. Program ends here

PROCEDURES

PROCbox	draw line around edges of screen
PROCnumber	loops through all SC% values. S% holds sum of all values. SKW%, SD1%, SD2% used for standard deviation. MEAN% holds mean value in hundredths of a second.
PROCdump	taken from **A&B** Computing, vol.1, no.3
PROCframe	draws the target square around X%,Y%
PROCscale1	draws a vertical scale for time
PROCscale2	draws a horizontal scale, each line represents 100 screen points
PROCmean	runs through all values of SC% with a loop defined by H%. A second loop (HF%) calculates the mean of the 20 values preceding the current value of H%. A line to this value is drawn. Process is repeated for each SC%; this filters extreme values
PROCdist	draws the scatter-diagram. Each point plotted with help of AF%(H%) horizontally and SC%(H%) vertically

PROGRAM CONVERSION

Program 1 — horizontal movements
The listing of program 1 is provided in full.

Program 2 — vertical movements
Make the following changes to program 1:
— delete lines 115 and 185
— add two new lines :
105 X% = 200:C% = 200:GOTO 120
175 GOTO 190

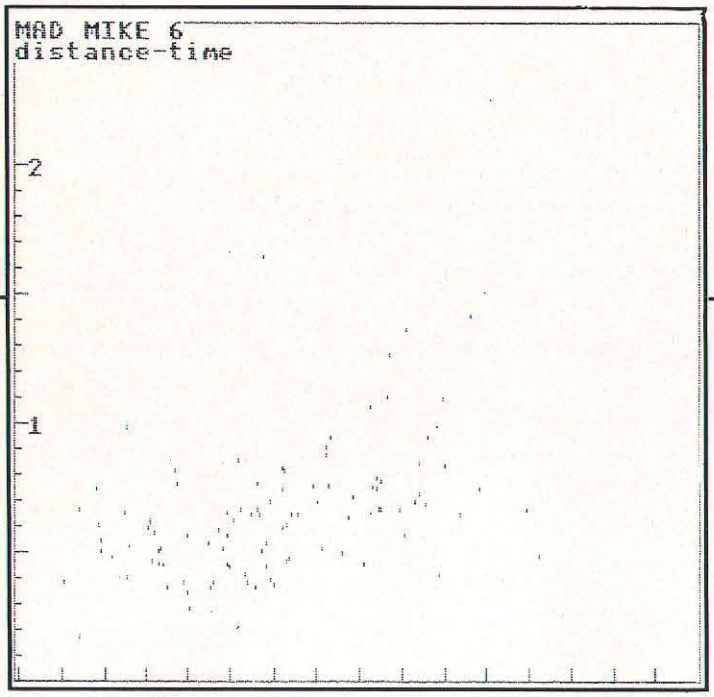
Program 3 — combined movements
Make the following change to program 2:
— delete lines 105 and 175

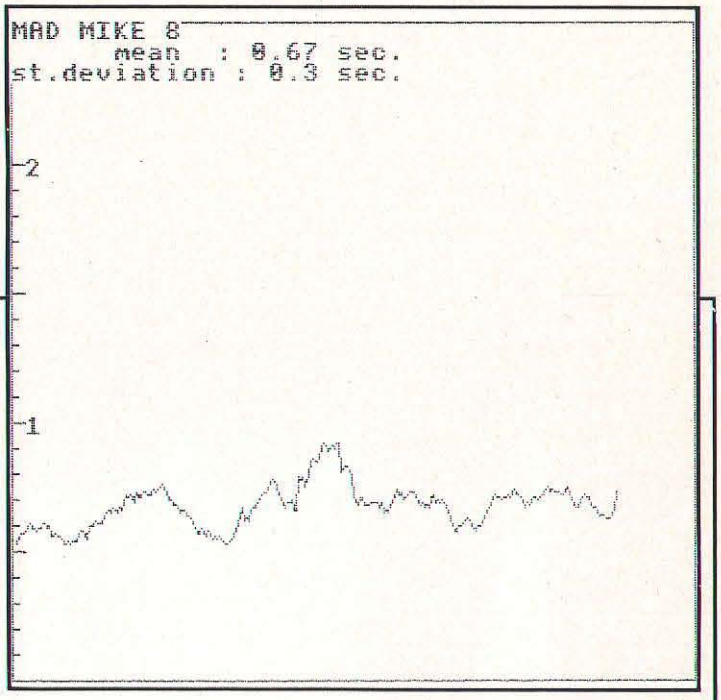
Program 4 — evaluation of single movements
There are more changes to the first section of the program now. Lines 10-330 are changed and one new procedure is added, which is listed.

PROGRAM LISTING

```
    5 REM PROGRAM 1
   10 MODE 4
   20 SOM%=300
   30 INPUT "What label ",A$:CLS
   40 PROCbox:MOVE650,512:DRAW630,512:MOVE640,502:
DRAW640,522
   50 DIM SC%(300):DIM AF%(300)
   60 GCOL4,0
   70 IF (ADVAL(0)AND3)=2 THEN 90 ELSE 70
   80 ************************
   90 FOR H%=1TO SOM%
  100 A%=640:B%=512
  110 X%=RND(1270)
  115 Y%=800:D%=800:GOTO130
  120 Y%=RND(1020)
  130 AF%=SQR((X%-K%)^2+(Y%-L%)^2):IF AF%<=80 THEN
 GOTO110
  140 PROCframe
  150 NOW=TIME
  160 REPEAT
  170 MOVE640,512:DRAW A%,B%
  180 C%=1279-ADVAL(3)*1279/65520
  185 GOTO200
  190 D%=ADVAL(4)*1279/65520
  200 MOVE640,512:DRAW C%,D%
  210 A%=C%:B%=D%
  220 UNTIL ABS(X%-A%)<40 AND ABS(Y%-B%)<40
  230 SC%(H%)=TIME-NOW
  240 AF%(H%)=SQR((X%-K%)^2+(Y%-L%)^2):K%=X%:L%=Y%
  250 SOUND1,-10,100,2
  260 IF (ADVAL(0)AND3)=2 THEN GOTO270 ELSE 260
  270 PROCframe:MOVE640,512:DRAW C%,D%:NEXT
  280 ************************
  290 CLS:GCOL0,1
  300 PROCmean:PROCnumber
  310 G$=GET$:IF G$="D"THEN PROCdump ELSE GOTO320
  320 CLS:PROCdist
  330 V$=GET$:IF V$="D"THEN PROCdump:END ELSE END
  340 ************************
  350 DEFPROCbox:MOVE0,0:DRAW1279,0:DRAW1279,1020:
DRAW0,1020:DRAW0,0:ENDPROC
  360 ********************
  370 DEFPROCnumber
  380 S%=0:SKW%=0:FOR H%=1TO SOM%:S%=S%+SC%(H%):SK
W%=SKW%+SC%(H%)*SC%(H%):NEXT
  390 MEAN%=S%/SOM%:SD1%=(SKW%-S%*S%/SOM%)/(SOM%-1
)
```

CONTINUED OVER






```
  400 SD2%=SQR(SD1%)
  410 PRINT"       mean   : ";MEAN%/100;" sec.":PRIN
T"st.deviation : ";SD2%/100;" sec."
  420 ENDPROC
  430 ********************
  440 DEFPROCdump
  450 *FX6,0
  460 VDU2
  470 VDU1,27,1,65,1,8
  480 FOR LL%=0 TO 39
  490 VDU1,27,1,75,1,0,1,1
  500 FOR TT%=31TO0STEP-1
  510 FOR GG%=7TO0STEP-1
  520 VDU1,?(HIMEM+TT%*320+GG%+LL%*8)
  530 NEXT:NEXT
  540 VDU1,13,1,10
  550 NEXT
  560 VDU1,27,1,50,3
  570 ENDPROC
  580 ************************
  590 DEFPROCframe:MOVE X%-40,Y%-40:DRAWX%-40,Y%+4
0:DRAWX%+40,Y%+40:DRAWX%+40,Y%-40:DRAWX%-40,Y%-40:
ENDPROC
  600 ************************
  610 DEFPROCscale1:FOR H%=10TO200STEP10:MOVE0,4*H
%:DRAW15,4*H%:NEXT
  620 FOR H%=50TO200STEP50:MOVE0,4*H%:DRAW25,4*H%:
NEXT
  630 VDU5:MOVE25,810:PRINT"2":MOVE25,410:PRINT"1"
:VDU4:ENDPROC
  640 ************************
  650 DEFPROCscale2:FOR H%=0TO1500STEP100:MOVE 10+
H%*1280/1620,0:DRAW10+H%*1280/1620,20:NEXT:ENDPROC
  660 ************************
  670 DEFPROCmean
  680 PROCbox:PROCscale1:PRINT A$
  690 S%=0:FOR H%=20TO SOM%:S%=0
  700 FOR HF%=H%-19TOH%:S%=S%+SC%(HF%):NEXT:MEAN%=
S%/20
  710 IF H%=20THEN MOVE10+4*H%-80,4*MEAN%ELSE DRAW
10+4*H%-80,4*MEAN%
  720 NEXT:ENDPROC
  730 ************************
  740 DEFPROCdist:PROCbox:PROCscale1:PROCscale2:PR
INT A$:PRINT"distance-time"
  750 FOR H%=1TO SOM%:MOVE 10+AF%(H%)*1280/1620,4*
SC%(H%):DRAW 10+AF%(H%)*1280/1620,4*SC%(H%)-4
  760 NEXT:ENDPROC
```

PROGRAM LISTING

```
  5REM PROGRAM 2 DELETE 115, ADD
105 DELETE 185 ADD 175
105 X%=200:C%=200:GOTO120
175 GOTO 190
```

PROGRAM LISTING

```
  5 REM PROGRAM 3 WITHOUT 105,115,
175,185
```

PROGRAM LISTING

```
   5 REM PROGRAM 4
  10 MODE 4
  20 SOM%=30
  40 PROCbox:MOVE650,512:DRAW630,512:MOVE640,502:
DRAW640,522
  50 DIM SC%(300):DIM AF%(300)
  60 GCOL4,0
  70 IF (ADVAL(0)AND3)=2 THEN 90 ELSE 70
  80 ************************
  90 FOR H%=1TO SOM%
 100 X%=RND(1270):Y%=800
 130 AF%=SQR((X%-K%)^2+(Y%-L%)^2):IF AF%<=80 THEN
 GOTO90
 140 PROCframe
 150 NOW=TIME
 153 N%=0
 155 IF H%=1 THEN MOVE640,512:DRAW A%,B%
 160 REPEAT
 165 N%=N%+1
 170 MOVE640,512:DRAW A%,B%
 180 C%=1279-ADVAL(3)*1279/65520
 190 D%=800
 200 MOVE640,512:DRAW C%,D%
 210 A%=C%:B%=D%
 215 SC%(N%)=A%
 220 UNTIL ABS(X%-A%)<40 AND ABS(Y%-B%)<40
 270 PROCREST
 280 IF (ADVAL(0)AND3)=2 THEN  NEXT ELSE 280
 330 G$=GET$:IF G$="D" THEN PROCdump:END ELSE END
>1000,1010
1000  DEFPROCREST
1010  PROCframe:KL%=300-SC%(1)/4:MOVE10+30,300:FO
R QH%=1TO N%:DRAW10+30*QH%,SC%(QH%)/4+KL%:NEXT:END
PROC
```

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Intelligent Systems and the Micro

Jonathan Evans and Charlie Ellis

What is an Expert System and can we hope to use one in the near future?

This article started out as a review of the package of programs for the BBC micro called HULK (Helps Uncover Latent Knowledge) by Brainstorm Computer Solutions. We were intrigued by the advertising of this package which claims to aid decision making, since we were curious to know what could be done within the confines of a 32K Micro.

Unfortunately, not only were we disappointed by the general quality of the programs and documentation when they arrived, but dismayed to find a clear attempt to imply that it constituted some kind of "Expert System" which it patently does not. It occurred to us that many users of microcomputers might not be sufficiently informed about Artificial Intelligence (AI) and Expert Systems to realise that packages for small micros at this sort of price cannot possibly resemble the genuine article. Hence, before we review the Hulk package as such, we will give a brief history of research into "intelligent" computer systems.

HISTORICAL BRIEF

The history of AI as an academic discipline is almost as old as that of computing itself. The original goal remains that of attempting to write computer software that will behave intelligently, by human standards, but the approach taken has changed considerably over the years. In the 1950s and 60s it was assumed that intelligence was based upon general reasoning abilities. Hence a lot of effort was expended in trying to produce intelligent behaviour in artificial environments such as chess playing. The interest at this time was not in making computers good chess players for the sake of it, but rather to learn something useful about the nature of intelligence in general.

Early work in AI did indeed lead to some important insights, for psychologists as well as computer scientists. For example, it was discovered that the method chosen to represent the relevant features of a problem could have a profound influence upon the ease of its solution. There were also developments in what have come to be known as "heuristic" problem-solving methods, which arose out of the need to deal with a difficulty inherent in computational attempts to solve a large variety of problems, that of "combinatorial explosion".

Imagine a simple problem such as the game of "Nim". At the outset we have a choice of removing either one or two pegs, our opponent then has a similar choice. Thus even after two turns we have four possible ways in which the play might have gone (1-1, 1-2, 2-1 or 2-2). By the third turn (our second move), the number of possible "paths" has risen to eight and this number will increase exponentially as the "depth" of our consideration continues. That is, the number of possible paths is two to the power of the number of turns.

In a more complex game such as chess, where there are both more potential turns and more choices at each stage, the number of paths to be considered becomes so huge so quickly that even with today's high-speed processors and vast RAMs it would take an unacceptably long time to consider every possible path. It should also be clear that such a "brute force" method is quite beyond the capacity of the human brain in terms both of working memory and of processing speed.

Clearly then, human problem-solvers must use techniques that substantially reduce the number of alternatives to be considered — and it has been found that such "heuristic" techniques as have been identified as being used by humans can very considerably improve the efficiency of problem-solving by computers.

Recent years have seen a shift of emphasis in AI research towards knowledge-based systems, as witnessed by the appearance of two new (and, regrettably, somewhat ill-defined) buzz-words, "Intelligent Knowledge-Based Systems" (IKBS) and "Expert Systems". The theoretical change was brought about by the realisation that human intelligence depends upon the vast range of knowledge which we bring to any problem. Indeed the only reason that the general problem solving approach had some success in early AI work was that the human researchers used their own real world knowledge to produce an abstract representation of the problem for the program to go to work on.

A particular example of this was Allen Newell and Herb Simon's General Problem Solver (GPS), a program which was designed on the basis of humans' commentaries as to how they themselves solved various abstract tasks. Given this basis, there is nothing particularly startling about the fact that the machine appeared to behave or "think" in a "human" way.

This shift in emphasis has both been made easier by, and resulted in, developments in software. We now have very high level languages such as LISP and PROLOG which are "symbol-manipulators" rather than "number-crunchers" and are based on formal mathematical systems (Lambda Calculus for LISP and First Order Predicate Calculus for PROLOG). The structure of and techniques available in these languages are intuitively closer to the way in which programmers think about the problems with which they are trying to deal than is the case with more traditional programming languages. Hardware advances have been relevant also, so that today's mainframe computers have the ability to handle huge databases at very high speeds. Even so computer systems at present cannot begin to handle knowledge equivalent to that of a human being, so all Expert Systems are in practice confined to very limited problem areas such as highly specialised types of medical diagnosis or chemical analysis.

EXPERT QUALIFICATIONS

We have said that the term "Expert System" is somewhat ill-defined — there are almost as many subtly different definitions as there are subtly different definers, ranging from the snappy "LOGIC + CONTROL = ALGORITHM: ALGORITHM + KNOWLEDGE = EXPERT SYSTEM" to the extremely verbose. Thus, rather than add to the confusion we shall try to identify the common strands.

To qualify for the description "Expert System" it is universally agreed that a program must solve difficult problems within a particular area of expertise and that its performance must be comparable with that of a human expert in terms of the quality of the solutions produced. Almost all would agree that an Expert System will invariably consist of three major components (see Fig.1), a knowledge base, an inference engine and a user interface, and that it will be used within the framework of a "consultation session".

To deal with the third component first, it is implicit in the idea of a "consultation session" that the program will be able to "explain" its reasoning on demand. That is, able to respond to questions from the user as to how an inference was made and why a particular question is being asked. The user interface will thus normally incorporate a natural language processor able to cope with at least a limited range of queries expressed in everyday language.

The knowledge base is a database containing a very large body of (often informal)

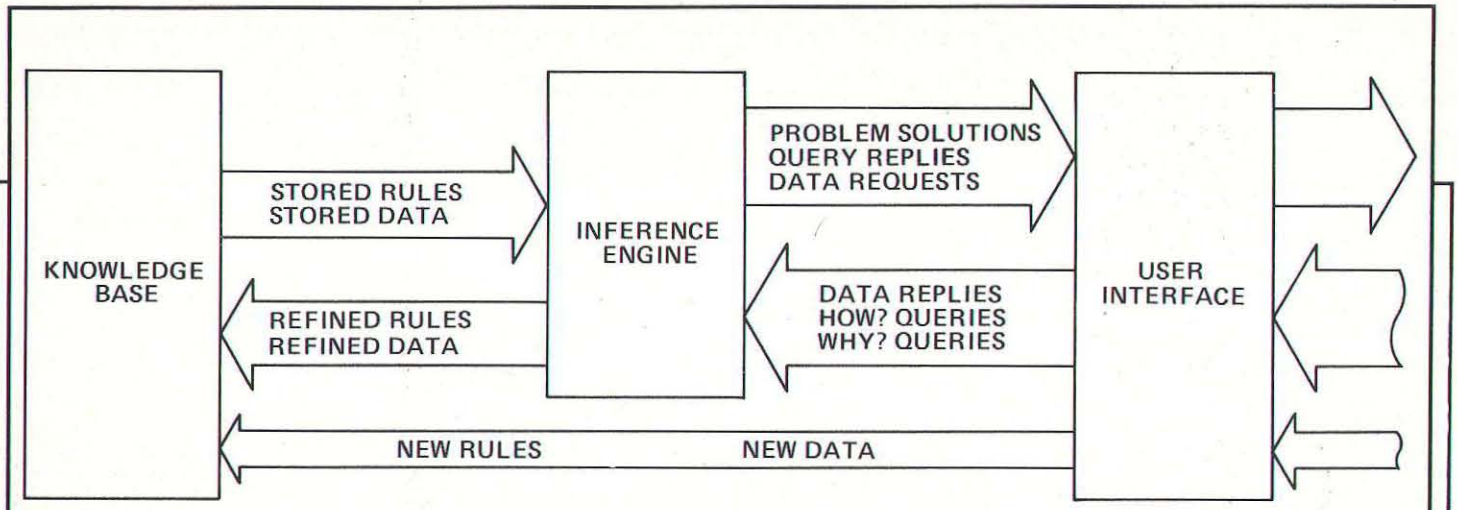


Figure 1. An expert system

knowledge about a particular problem area or "domain". To give an idea of the amount of knowledge involved, Mycin, one of the (very few) Expert Systems in actual use, has a knowledge base which required some twenty man-years of effort to build. Apart from actually eliciting the knowledge from a human expert (or, as in the case of Mycin, from a large number of human experts), an enormous amount of time is typically spent in numerous iterations of a test-refine-test cycle to "tune" the knowledge representation so as to make the program maximally efficient and to filter out inconsistencies (see Fig.2).

The knowledge will typically be held as a collection of facts and rules (or rules alone), such rules being frequently of the form "if X is true then Y is true" or "if X is true then do Y". Rules in this form are termed "production rules" or "condition-action pairs" and work on the principle that if their condition is true then their action (which may be simply the assertion of a fact) is carried out. Certain of the rules may have conditions which are true at the outset, whilst the conditions of other rules may become true (or cease to be true) as a result of new data which might be volunteered by or requested from the user, or inferred by the program itself.

The heart of the Expert System is the inference engine, the part of the program which embodies the algorithms for eliciting information from the user, searching the knowledge base and generating inferences. Since "real-world" knowledge frequently involves probabilities (for example, "if X is true then there is a 75% probability that Y is true"), and since the data will frequently be uncertain (for example, we may know that readings from a particular sensor have a tolerance of plus or minus 10%), the inference engine must be able to handle uncertainty in arriving at a solution.

The ways in which uncertainty has been approached are many and varied. Mycin, for example, uses "plausible inference", a variant of Bayesian Probability Theory, whilst other systems have been based (at least loosely) upon "fuzzy logic", measures of belief and disbelief and formal theories of evidence. What these various approaches have in common, however, is that they are ad hoc solutions to the problem. They have all, at least to some extent, been cobbled together to produce an "acceptable" result. There simply is no "correct" way of arriving at decisions from uncertain evidence.

KNOWLEDGE ENGINEERING?

Most significantly, no two working Expert Systems share precisely the same inference engine. Inference engines have all to date been "domain-specific" and have in practice had to be built and refined for a specific task. So-called Expert System "shells" have appeared, but these have proven to be virtually worthless for any non-trivial application. This is hardly surprising when one learns that almost without exception these shells have started life as Expert Systems (although not necessarily working Expert Systems), and have been produced by stripping out the domain-specific bits so as to leave a "general" shell.

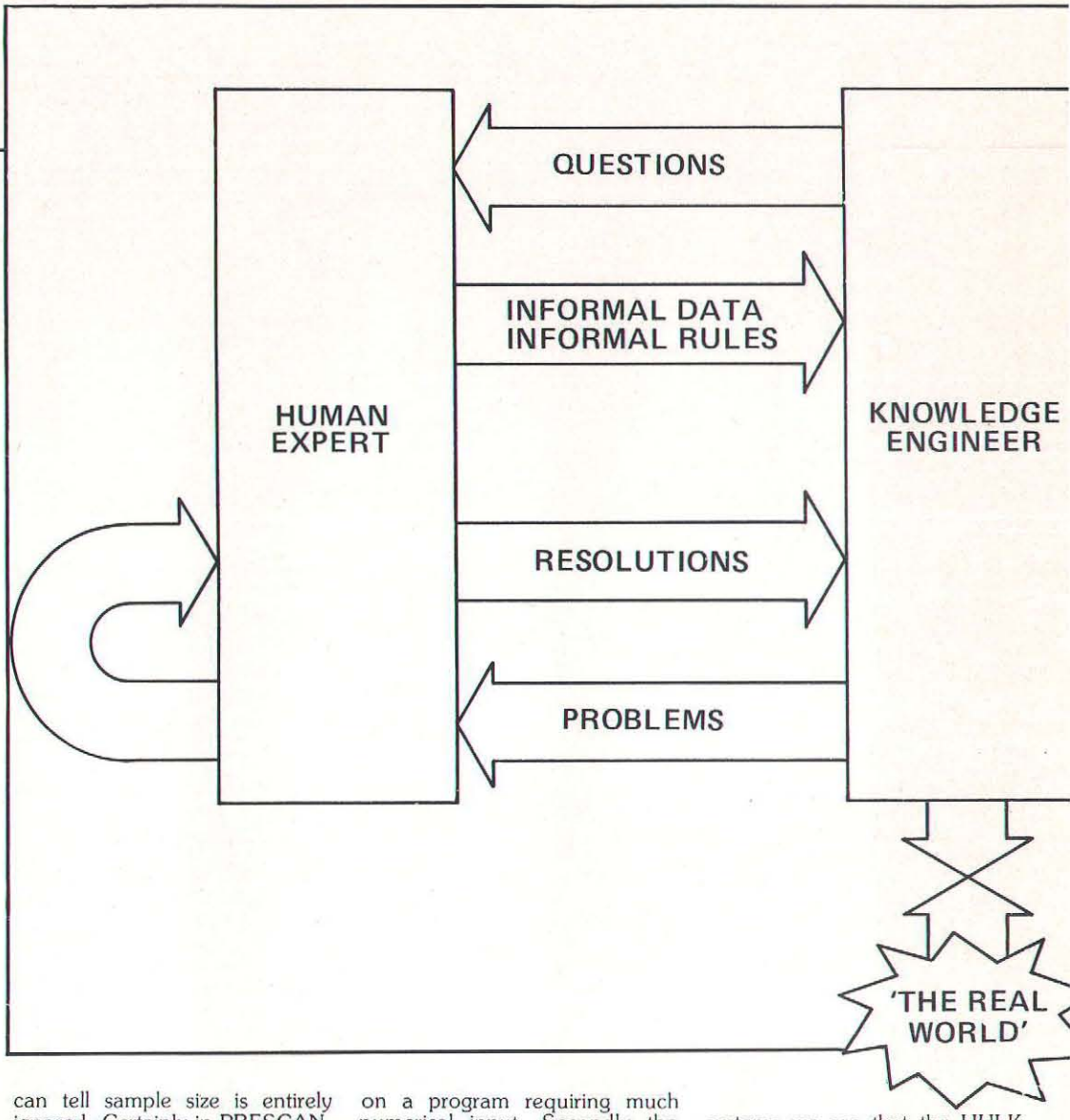
Given the size of the knowledge base required, it is clear that no program with a genuine claim to the description "Expert System" could physically be accommodated in a personal microcomputer of the size currently available, nor producible at a "home micro" price. Hence our concern at phrases such as the following in the documentation accompanying the HULK package. "The HULK is a poor man's knowledge engineer. A knowledge engineer is someone who knows how to build an expert system"; "HULK lets you dip your toes into the warm blue lagoon of Expert Systems and find out what the fuss is about." Note that they are not actually saying that HULK *is* an expert system, but these phrases carry misleading implications.

What kind of knowledge engineer is the HULK package? Firstly, it has no knowledge of a problem domain — you must be your own expert and supply it yourself. Another immediate limitation is that the program can only handle statistical problems of a particular structure. The knowledge base which is established has "facts" — statistical samples measured under a number of different variables and "rules". No user interface is provided for the facts part at all. You must compose your own data files according to instructions in the "User Guide" though example files are provided. There are, however, two programs which help you to construct the rules part of the database: PRESCAN and LOOK. A further program, LEAP, utilises the database to make predictions about new samples, thus presumably claiming to provide the "inference engine".

The inferences with which HULK is concerned are all of a given form. One of the variables of the sample must be predicted from values measured on others. Let us consider a practical example where such an analysis would be important. (This example is our own and not one of the supplied data files in the package.)

Suppose one conducted a medical research project where one wished to discover which patients were most likely to benefit from a particular form of treatment. A number of patient characteristics such as age, sex, weight, family history etc might be potential predictors of a special variable among the set which measures effectiveness of the treatment. Some factors might be irrelevant, some more relevant than others and so on. If one could discover a good rule for predicting which patients would benefit from the treatment this would have obvious practical

CONTINUED OVER



benefits in deciding what treatment to use on new patients who are measured on the predictor variables.

In using HULK you must always define which variable is the one to be predicted. The rules you try to evolve must involve the relation of other variables to this. For example, with the medical example if you enter "age 35" as a rule the program would see whether people over 35 were more (or less) likely to benefit from the treatment. A sample must always be examined to test the effectiveness of the rule. This is done in detail by LOOK (PRESCAN merely helps identify relevant variables). The program advises on how good a predictor your rule is and you may choose to retain or reject it. Other rules involving other variables (or combinations of variables) may then be tested.

The handbook claims that the program may reject rules which are effective in their own right but redundant due to rules previously accepted. However, our own tests with one of the supplied data files revealed alarming flaws here. We found that LOOK would sometimes accept not only highly redundant rules but even identical repeated rules, and furthermore increase its overall level of confidence in its predictive ability. This suggests unsound algorithms, though we gave up trying to understand its methods after hours of studying the program listing — whatever it does, it is complex. Note how removed the program is here from the objective of an expert system that it should be able to explain its reasoning!

Once the rule file has been saved by LOOK, the program LEAP uses it in conjunction with (hopefully) a separate data file to make your predictions. Again, the mechanism of inference is explained neither by the program nor by the handbook. Now for the real criticisms of the system.

Firstly, from a statistical point of view there are several deficiencies. A crucial factor in statistical inference is sample size — larger samples provide more accurate predictions. So far as we can tell sample size is entirely ignored. Certainly in PRESCAN, where the algorithms are readable, the analysis is carried out as though all samples were very large when they can be as small as four!

Secondly, while the handbook does suggest that separate data files should be used by LOOK and LEAP and double example files are provided, it is not made sufficiently clear that to extract rules from a set of data and then make predictions on the same set would be totally meaningless.

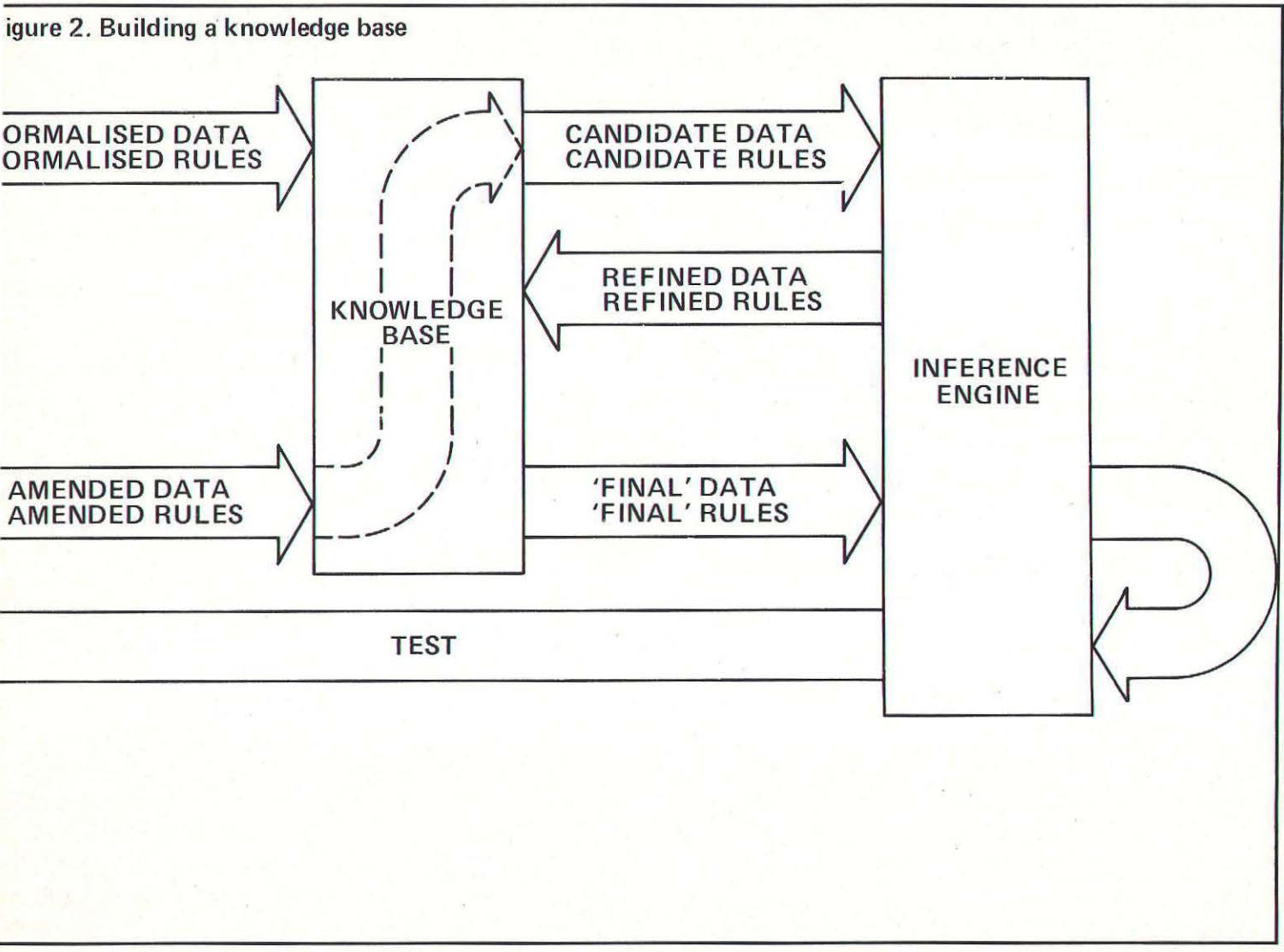
Next we consider the user interface. It is frankly one of the most unfriendly packages we have ever seen. The programs are easily crashed, eg by entering the name of a data file not on the disc, and even the Escape key is not trapped. This is unforgiveable on a program requiring much numerical input. Secondly the screen displays are poor, making little use of the excellent teletext display facilities available in Mode 7. We are mostly given messy displays of numerical data whose meaning is frequently inadequately explained, and in places they scroll straight off the screen.

The documentation, though substantial, in no way explains the programs and their use in a way likely to be comprehensible to anyone who is not already expert in statistical methods (and even then it is very hard work). An accompanying document to the HULK package states that the programs were originally written in two weeks but a further six months were spent increasing its user friendliness. At least half of this claim would seem plausible.

Looked at in terms of expert systems we see that the HULK has no knowledge, so at best could claim to be a shell program. Its user interface in both developing and applying rules is most unfriendly and in no way explains how it reasons.

There are also serious deficiencies in the "inference engine". The user is not permitted to express degrees of certainty in either the facts or the rules. The only handling of uncertainty is via some dubious statistical analysis that the program performs on the data files themselves. The most dangerous aspect of the package is that there are no checks for consistency, redundancy or completeness of the rule set developed. The user could easily end up with a very inefficient set of rules because he or she did not have sufficient

igure 2. Building a knowledge base



knowledge or imagination to try the right rules. LEAP would then function as a dangerously *inexpert* system.

We must emphasise that no-one should consider applying HULK to the solution of any serious problem such as the medical research example discussed above. Apart from the flaws of the program, its limitation to multivariate statistical samples makes it quite redundant. Powerful objective methods of statistical analysis, such as multiple regression, are available to extract the optimum predictions from such data. Indeed, there is no point at all in trying to develop knowledge engineering in such domains, since both the facts (measures in statistical samples) and rules (laws of mathematical statistics) are objectively available.

INTELLIGENCE – THE COST IS HIGH

The reader will have gathered by now that we do not believe that any kind of expert system can be written for a small personal computer, and that the HULK Package itself is as poor as it is pretentious. We should, however, not want to give the impression that useful decision support software cannot be written for a computer like the BBC micro. For example, there are decision aids which do not contain knowledge of the problem domain but function by helping the user to "structure" the decision problem and think his or her way systematically through the options and consequences associated with the decisions.

Knowledge based decision aids of a limited nature might be possible too, though it is doubtful whether they could be described as intelligent. For example, software has been written on personal computers to aid pharmacists in labelling prescribed items, which utilises specialist databases to print warnings on labels and the like. Using random access files on discs it is possible to construct structured databases of sufficient size to provide useful information required by someone making decisions in a narrow problem domain.

Looking further into the future, when can owners of personal computers expect to have anything resembling a genuine expert system? Obviously, the continued rapid advance in hardware — especially in mass storage systems such as video discs — will increase its feasibility. The cost of developing expert systems is, however, very high, which will make the software expensive unless it can be utilised for problems which have importance for large numbers of people.

There are also still a large number of technical and philosophical issues concerning the whole question of whether and in what way computer programs can be made genuinely intelligent. Nevertheless, we would be rash indeed to predict what might or might not be available on your desk top within the next few years.

Hulk is distributed by Warm Boot Limited, Finsbury Business Centre, 40 Bowling Green Lane, London EC1R 0NE. Price £25 plus VAT.

Bouncer

Margaret Stanger

The culmination of our super arcade game. Start sending your hi-scores now.

The final article in the series completes the Bouncer game and includes four listings:

SOURCE4 assembles the remaining machine code, MC4, and TEST4 tests this code and makes sure that it is correct.

There is a short BASIC program, TOPSIX, which contains the hall of fame routine for the game. The four machine code sections can be added to TOPSIX to complete the main program BOUNCE. All that the program now needs is a short loader program BOUNCER to display the instructions and CHAIN the main part of the game.

THE SCORE

Each score is stored in two different ways, in normal hexadecimal form, and in binary decimal form for use in the display.

Figure one shows the locations used for these values.

&D7C	Score to be added	Digits
&D7D	Score to be added	Tens
&D7E	Score to be added	Hundreds
&D7F	Score to be added	Thousands
&D91	Score to be added	Low byte
&D92	Score to be added	High byte
&D88	Level	Digits
&D89	Level	Tens
&D8E	Level	One byte
&D77	Bonus	Low byte
&D78	Bonus	High byte
&D79	Bonus	Tens
&D7A	Bonus	Hundreds
&D7B	Bonus	Thousands
&D80	Score	Digits (always zero)
&D81	Score	Tens
&D82	Score	Hundreds
&D83	Score	Thousands
&D84	Score	Ten thousands
&D85	Score	Hundred thousands
&D86	Score	Millions
&D87	Score	Ten millions
&D94	Score	Low byte
&D95	Score	Mid byte
&D96	Score	High byte

N.B. When the game is over the final score can be obtained during the BASIC part of the program. After clearing &D97, the score is obtained by !&D94.

As the scores always end in zero, the hexdecimal scores are multiplied by ten for the Hall of Fame routine.

After level 16, the level reverts to one, and when the score is maximum it starts again, just in case the numbers get too big for the scoreboard.

When the scenery is set up there is a bonus fruit POKEd on the screen on each branch. The "fruit flag" in location &D8F is set at 7.

Bit 1 is set when the top fruit is present.

Bit 2 is set when the middle fruit is present.

Bit 3 is set when the lowest fruit is present.

When the kangaroo punches the fruit a value is added to the score, the fruit is erased, and the relevant bit of the fruit flag is cleared.

ODDS AND ENDS

There are several ways to alter the difficulty level of the program and adjust the odds in favour of the user. The game could start with three extra lives instead of two, and the delay factor between the frames could be changed. The top six scores could be lower to start with, or you could include your own scores and names.

The bonus could go down more quickly or more slowly, or even start at a different level. With the bonus starting at 4000 instead of 5000, even our expert found that on level four he was still stranded under the ladder when the time ran out.

HOW TO GET IT TOGETHER

Set PAGE = &4000.
Type NEW.
Type in SOURCE4.
SAVE "SOURCE4" just in case of accidents.

RUN SOURCE4 which will
* SAVE a copy of the assembled machine code MC4.

When you have SAVEd your final version of SOURCE4 and RUN it to *SAVE MC4:
Set PAGE = &1900.
Type NEW.
Type in TEST4.
SAVE TEST4.

RUN TEST4 which will LOAD the machine code MC1, MC2, MC3 and MC4 from each part of this series.

MC3 will be downloaded by the program into the right location.

RUN TEST4 to test all the machine code. Now,
Set PAGE = &1900.
Type NEW.
Type in TOPSIX, which forms the BASIC part of the program.
SAVE "TOPSIX".
*LOAD MC1
*LOAD MC2
*LOAD MC3
*LOAD MC4
*SAVE "BOUNCE" 1900 3FFF 801F

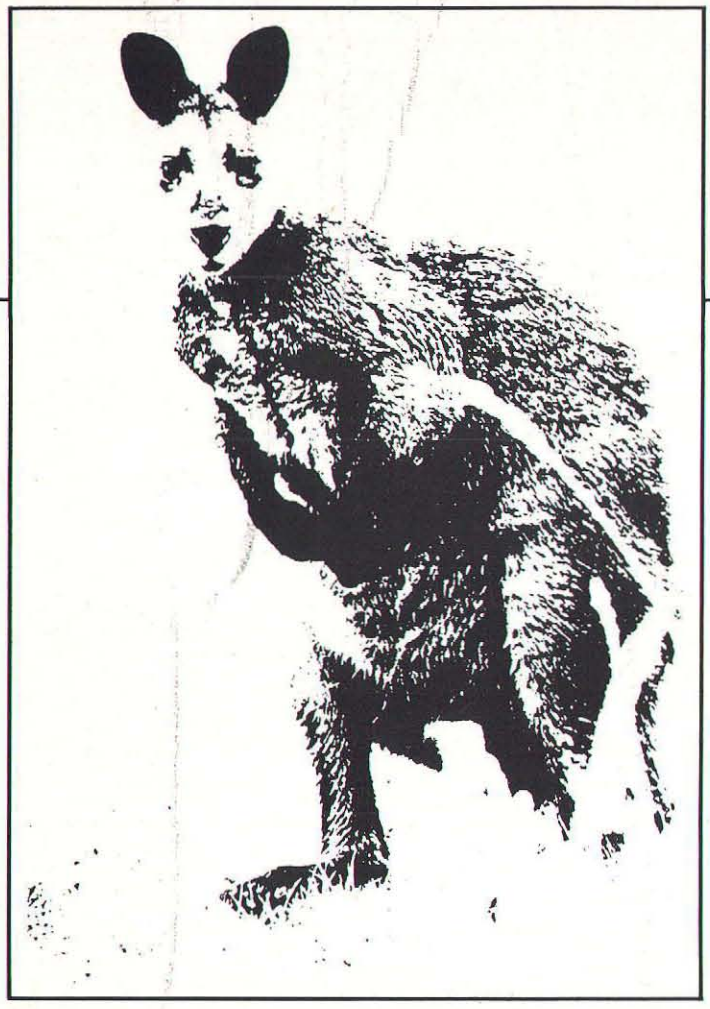
BOUNCE now contains all the relevant parts in one program and only needs a Loader program BOUNCER to save you having to LOAD each part separately. The loader also contains the instructions for the game.
SET PAGE = &1900.
Type NEW.
Type in BOUNCER
to complete the program.

BOUNCER SOURCE4 MAIN PROGRAM

Line	
20	Clears Hall of Fame area.
30	Puts names and scores into top six.
40-50	Puts messages into memory.
60	Reads Data for header.
70	Accesses initialisation routine.
80	Assembles machine code.
90	Saves machine code.

PROCEDURES

120	PROCIN Defines labels.
170	PROCAS
180	Sets assembly options.
190-220	LIVES This routine POKEs the number of remaining



kangaroo lives in the top left hand corner of the tree. There is provision in this routine for an extra life.

230 HEADER Prints the header.

240 GAMEOVER Prints 'GAME OVER' with a delay between each letter.

250-280 SETUP
This combined routine adjusts the palette, prints the header and POKEs the animals and lives. Set the bonus to 5000 and sets the fruit flag. Prints bonus, level and score, and POKEs the three fruits in position on the screen.

290 PB prints the bonus.

300 PL prints the level.

310 PS prints the score.

320-330 ADL
Adds 1 to level in Hex and binary decimal.

340-410 ADSC
Adds to score in Hex and binary decimal.

420 ZER Zeros all scores and sets the values for the start of each game (i.e. Level 1,2 remaining lives, and sets the delay factor in &D97 to &F9 (longest). Copies the keyboard flag into &D70).

430-450 BON
Subtracts 1 from bonus in hex and binary decimal.

460 SC
Calls rescue and calls bonus three times.

470 Checks if the kangaroo is punching a fruit and accesses fruit scoring routine.

480 If a death has occurred, subtracts 1 from remaining lives and sets the scene again.

490-510 Fruit scoring. Adjusts score and fruit flag.

520-550 FSC
adds 800, 400, 200, 100 to score for pineapple, cherry, tomato and strawberry.

560 RES the rescue.
Checks for top of ladder.

570 Adds bonus to score.

580 Adjusts pitch of squeak, adds 1 to level and POKEs a picture of Joe without his blindfold.

590 Message appears, the scene is setup at the next level after a delay.

600 FP Final Product.
All routines are combined here, control only returns to Basic when all lives have been lost.

610 MISSILE
The data for each missile is copied to the zero page work area.

620 Checks if kangaroos head or feet have been hit.

630 Checks if missile is punched or dodged.

640 Checks for ducking kangaroo on branch 2.

650 Checks for hit. Checks for hit by mid move position of apples.

660 Calculates tree position of kangaroo's head.

670 Check for hit on middle branch.

680 Clears death flag if kangaroo is ducking.

BOUNCER TEST4 MAIN PROGRAM

Line

20 This can be used to bypass the next five lines if necessary.

30-60 Loads machine code.

70 Downloads MC3 into position. This machine code may be overwritten if BREAK is pressed.

80 Sets mode, removes cursor, accesses initialisation routine.

90 Game procedure.

PROCEDURES

120 PROCGAME sets the flag for keys rather than joystick at this stage.

130 Zeros scores, CALLs SETUP. The scenery and headings are printed and the characters and remaining lives POKEd onto the screen.

140 CALLS GAME and rescue routine.

150 Calls GAME, and all the scoring and interaction until all three lives have been lost.

160 CALLS FP (final product) which includes all the other routines.

180 PROCIN defines labels.

HINTS ON TESTING

The envelopes could be included if desired.

Once SETUP and ZER are found to be correct, the rescue routine on the next line can be tested. When the kangaroo reaches the top of the ladder, the bonus is added to the score, Joe loses his blindfold, recognises 'MOM', and squeaks. This alerts the monkeys who arrange for him to be held in a new jail in a different tree. After every fourth rescue the bonus fruit changes and the speed increases until level 17 after which it reverts to level 1. The death flag is not recognised at this stage to make the game easier to test.

When this part of the program is working, line 140 can be removed or bypassed to test the

CONTINUED OVER

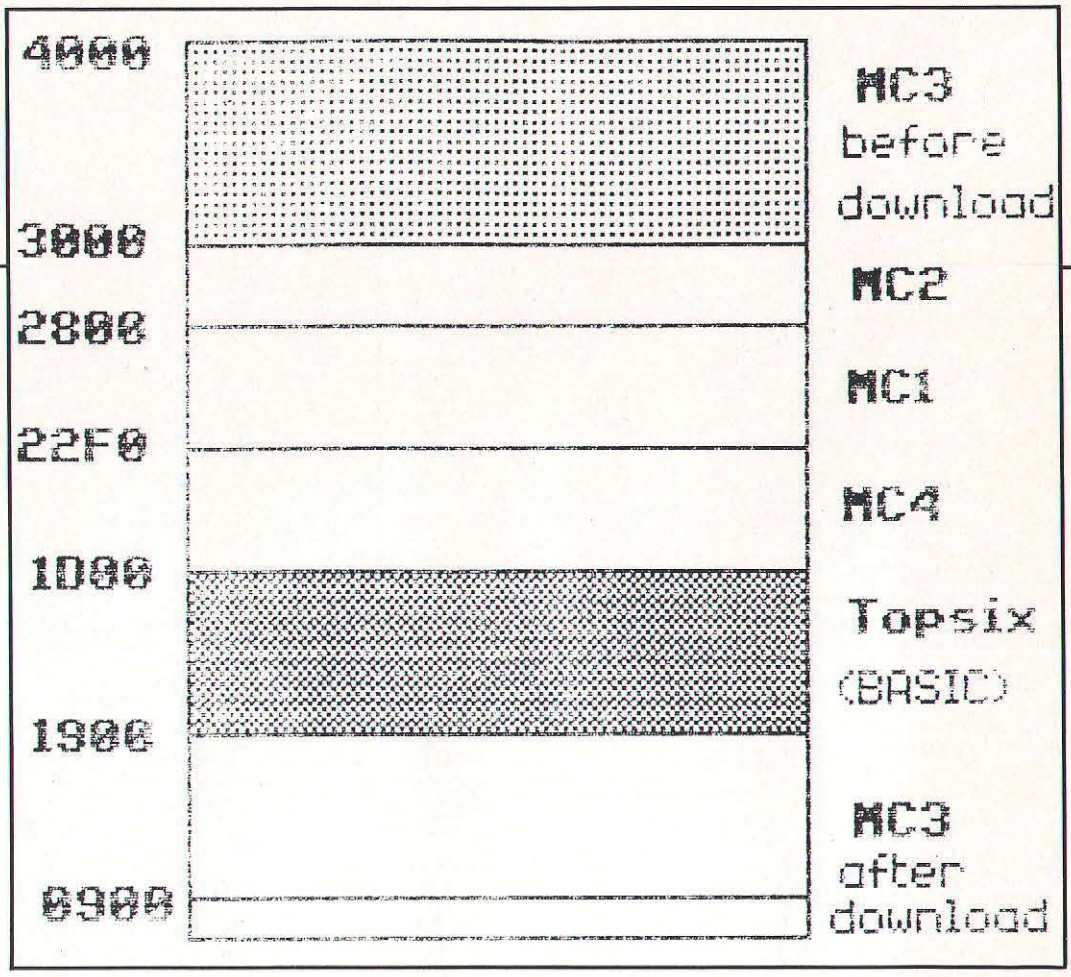
scoring and interaction. Check that all missiles hit the kangaroo which should also perish if she runs out of time or falls off a ladder or a branch. The game should restart with the same score and one less life until all the lives have been lost. The kangaroo can punch a bonus fruit to score, or punch a missile on the top or bottom branch. She must duck under or jump over the missiles on the middle branch to avoid disaster.

When all is well with the scoring, bypass lines 130 and 150 to test the final version of the game on line 160.

Once this is correct the instructions and Hall of Fame are added to finish the game.

BOUNCER

This program prints the instructions, sets or clears the keyboard flag, and CHAINs in the second part of the program. As the instructions make use of some of the MODE 7 teletext codes, Electron owners may prefer to write their own.



Full memory map

Line	
20	Defines envelopes.
30	To make sure that the first line of scenery is not lost on some monitors or TVs.
40	Sets MODE 7, removes cursor.
50-190	Prints instructions.
200-240	Waits for SPACE or FIRE to be pressed to set or clear the keyboard flag.
250	CHAINs main program.

TOPSIX

This program has to be squashed to make room for the machine code which starts at &1D00.

Variables A%, B% and F% are used as described in the text.

MAIN PROGRAM

Line	
20	Turns off Disc system (if fitted).
30	Dowloads MC3.
40	Zeros score, prints Hall of Fame, clears keyboard buffer.
50	Frees cursor keys from editing.
60	Waits for RETURN to be pressed. Selects MODE 2. Calls the game (FP) and stores the keyboard flag afterwards.

PROCEDURES

70	PROCS Prints message, B% letters long starting from address A%.
80	PROCR Swaps name from position B% to position A%.
90	PROCQ The Hall of Fame routine. Checks if the score qualifies and stores rank F%.
100	Shuffles the names below F% one further down.
110	Prints the top six.
120	Puts in the name if necessary.
140	PROCN Enters the name. Prints message.
150	Takes auto repeat off keyboard.
160	Flushes keyboard buffer.
170	Restores cursor keys to edit function.
180	Gets letter and prints it.
190	Checks for end of name, clears the string if all name deleted.
200	Puts the name into position and sets keyboard auto repeat to minimum.

FINALLY . . .

Congratulations to those of you who have typed in the whole of the game. I hope that you will find the game worth the effort. Many of the routines described are portable and you may find a use for them in your own programs. Remember though that the articles describe one way of writing a complex game. There are other approaches and other programmers may tackle their problems in different ways.

PROGRAM LISTING 1

```
  10REMBOUNCER SOURCE4 BY M.STANGER
  20FORX%=0TO&EF:?(&2200+X%)=0:NEXT
  30FORX%=0TO5:!(&2208+4*X%)=150*(6-X%):$(&2228+16*X%)
="A&B COMPUTING":NEXT
  40$(&2296)="HALL OF FAME"
  50$(&22A3)="Please enter your name"
  60FORX%=0TO51:READA%:?(&22BA+X%)=A%:NEXT
  70PROCIN
  80PROCAS
  90*SAVE"MC4" 1D00 22EF 801F
 100VDU7:END
 110:
 120DEFPROCIN
 130SPIC=&2EC0:LPIC=&2EDA:OSWRCH=&FFEE:WAIT=&2F34:HUE=
&2F0B:CHARS=&1625:DEL=&16A1:HALO=&176F:SQUEAK=&2F7A
 140JW=&12C3:WJ=&12C8:GAME=&1250:CHPIC=&1660:FW=&14D3:
WF=&14E1:RTREE=&13D2
 150ENDPROC
 160:
 170DEFPROCAS
 180FORPASS=1TO3STEP2:P%=&1D00:[OPTPASS
 190.LIVES LDX#0:.LVC LDA&22C8,X:JSR OSWRCH:INX:TXA:CM
P#14:BNE LVC:LDA&D90:CMP#3:BEQ LV3:CMP#2:BEQ LV2:CMP#1:
BEQ LV1:RTS:
 200.LV3 LDA#&20:STA&80:JSR LV:LDA#&40:STA&80:JSR LV:L
DA#&60:STA&80:JSR LV:RTS
 210.LV2 LDA#&40:STA&80:JSR LV:LDA#&60:STA&80:JSR LV:R
TS:.LV1 LDA#&60:STA&80:JSR LV:RTS
 220.LV LDA#&30:STA&81:LDA#&29:STA&71:LDA#0:STA&70:JSR
 LPIC:RTS
 230.HEADER LDX#0:.HE LDA&22D6,X:JSR OSWRCH:INX:TXA:CM
P#24:BNE HE:RTS
 240.GAMEOVER LDX#0:.GV LDA&22BC,X:JSR OSWRCH:INX:TXA:
PHA:LDA#&E0:STA&8B:JSR WAIT:PLA:TAX:CMP#14:BNE GV:RTS
 250.SETUP JSR HUE:JSR CHARS:JSR LIVES:JSR HEADER:LDA#
0:STA&D79:STA&D7A:LDA#5:STA&D7B:LDA#1:STA&D78:LDA#244:S
TA&D77:LDA#7:STA&D8F
 260JSRFR1:JSRFR2:JSRFR3:JSRPB:JSRPL:JSRPS:RTS
 270.FR1 LDA#&E0:STA&80:LDA#&54:STA&81:JSRFRPIC:RTS:.F
R2 LDA#&A0:STA&80:LDA#&64:STA&81:JSRFRPIC:RTS
 280.FR3 LDA#&80:STA&80:LDA#&66:STA&81:JSRFRPIC:RTS:.F
RPIC LDA&D8A:STA&70:LDA&D8B:STA&71:JSR SPIC:RTS
 290.PB LDA#31:JSR OSWRCH:LDA#1:JSR OSWRCH:LDA#3:JSR O
SWRCH:LDX#3:.B CLC:LDA&D78,X:ADC#&30:JSR OSWRCH:DEX:TXA
:BNE B:LDA#&30:JSR OSWRCH:RTS
 300.PL LDA#31:JSR OSWRCH:LDA#9:JSR OSWRCH:LDA#2:JSR O
SWRCH:CLC:LDA&D89:ADC#&30:JSR OSWRCH:LDA&D88:ADC#&30:JS
R OSWRCH:RTS
 310.PS LDA#31:JSR OSWRCH:LDA#13:JSR OSWRCH:LDA#2:JSR
OSWRCH:LDX#6:.PS1 CLC:LDA&D7F,X:ADC#&30:JSR OSWRCH:DEX:
TXA:BNE PS1:LDA#&30:JSR OSWRCH:RTS
 320.ADL INC&D88:LDA&D88:CMP#10:BNE ADL0:LDA#0:STA&D88
:INC&D89:.ADL0 INC&D8E:LDA&D8E:CMP#17:BNEADL2:LDA#1:STA
&D88:STA&D8E:LDA#0:STA&D89:STA&D8A:LDA#&F9:STA&D97:RTS
 330.ADL2:LDA&D8E:AND#3:CMP#1:BNE ADL3:INC&D97:CLC:LDA
&D8A:ADC#&20:STA&D8A:.ADL3 RTS
 340.ADSC CLC:LDA&D91:ADC&D94:STA&D94:LDA&D92:ADC&D95:
STA&D95:LDA&D93:ADC&D96:STA&D96:CLC:LDA&D7C:ADC&D80:STA
&D80:CMP#10:BMI ADSC1:LDA&D80:SBC#10:STA&D80:SEC
 350.ADSC1 LDA&D7D:ADC&D81:STA&D81:CMP#10:BMI ADSC2:LD
A&D81:SBC#10:STA&D81:SEC
 360.ADSC2 LDA&D7E:ADC&D82:STA&D82:CMP#10:BMI ADSC3:LD
A&D82:SBC#10:STA&D82:SEC
 370.ADSC3 LDA&D7F:ADC&D83:STA&D83:CMP#10:BMI ADSC4:LD
A&D83:SBC#10:STA&D83:SEC
 380.ADSC4 LDA#0:ADC&D84:STA&D84:CMP#10:BMI ADSC5:LDA&
D84:SBC#10:STA&D84:SEC
 390.ADSC5 LDA#0:ADC&D85:STA&D85:CMP#10:BMI ADSC6:LDA&
D85:SBC#10:STA&D85:SEC
 400.ADSC6 LDA#0:ADC&D86:STA&D86:CMP#10:BMIADSC7:LDA&D
86:SBC#10:STA&D86:CLC
 410.ADSC7 LDX#3:.ADSC8 LDA#0:STA&D90,X:DEX:BNE ADSC8:
LDX#4:.ADSC9 LDA#0:STA&D7B,X:DEX:BNE ADSC9:JSR PS:RTS
 420.ZER LDX#37:.Z1 LDA#0:STA&D71,X:DEX:BNEZ1:LDA#2:ST
A&D90:LDA#1:STA&D88:STA&D8E:LDA#&2E:STA&D8B:LDA#&F9:STA
&D97:LDA&70:STA&D70:RTS
 430.BON LDA&D77:BNE B2:LDA&D78:BEQ B3:DEC&D78
 440.B2 DEC&D77:DEC&D79:LDA&D79:BPLB1:LDA#9:STA&D79:DE
C&D7A:LDA&D7A:BPLB1:LDA#9:STA&D7A:DEC&D7B:LDA&D7B:BPLB1
 450.B3 LDA#1:STA&D8B:RTS:.B1 JSR PB:RTS
 460.SC JSR RES:JSR BON:JSR BON:JSR BON
 470.SC1 LDA&D8B:AND#1:BEQ SC4:LDA&D8C:CMP#&E3:BEQ SC2
:CMP#&CF:BEQ SC2:CMP#&61:BEQ SC3:CMP#&4D:BEQ SC3:CMP#&7
0:BEQ SC5:CMP#&5C:BEQ SC5
 480.SC4 JSRMISSILE:JSR HALO:LDA&D8B:BEQALIVE:LDA&74:B
EQALIVE:DEC&D90:LDA&D90:BMIALIVE:JSRSETUP:.ALIVE RTS
 490.SC2 LDA&D8D:CMP#&24:BNESC4:LDA&D8F:AND#1:BEQSC4:D
EC&D8F:JSRFSC:JSRFR1:RTS
 500.SC3 LDA&D8D:CMP#&25:BNESC4:LDA&D8F:AND#2:BEQSC4:L
DA&D8F:EOR#2:STA&D8F:JSRFSC:JSRFR2:RTS
 510.SC5 LDA&D8D:CMP#&25:BNESC4:LDA&D8F:AND#4:BEQSC4:L
DA&D8F:EOR#4:STA&D8F:JSRFSC:JSRFR3:RTS
 520.FSC LDA&D8E:CMP#4:BPL FSC2:.FT1 LDA#1:STA&D7D:LDA
#10:STA&D91:JSR ADSC:RTS
 530.FSC2 CMP#8:BPL FSC3:.FT2 LDA#2:STA&D7D:LDA#20:STA
&D91:JSR ADSC:RTS
 540.FSC3 CMP#12:BPL FSC4:LDA#4:STA&D7D:LDA#40:STA&D91
:LDA#0:STA&D92:JSR ADSC:RTS
 550.FSC4 LDA#8:STA&D7D:LDA#80:STA&D91:LDA#0:STA&D92:J
SR ADSC:RTS
 560.RES LDA&D0D:CMP#&24:BNE NRES:LDA&D0C:CMP#&6C:BEQ
RES1:.NRES RTS
 570.RES1 LDA&D77:STA&D91:LDA&D78:STA&D92:LDA&D79:STA&
D7C:LDA&D7A:STA&D7D:LDA&D7B:STA&D7E:JSRADSC
 580LDA#250:STA&2B8C:JSRSQUEAK:JSR ADL:JSR JW:JSRCHPIC
:JSRJW:LDA#&2D:STA&86:LDA#&C0:STA&85:JSRCHPIC
 590LDA#31:JSR OSWRCH:LDA#12:JSR OSWRCH:LDA#5:JSR OSWR
CH:LDA#238:JSR OSWRCH:LDA#239:JSROSWRCH:JSRDEL:LDA#30:J
SROSWRCH:JSR SETUP:RTS
 600.FP JSRZER:JSRSETUP:.FP1 JSRGAME:JSRSC:LDA&D90:BPL
 FP1:JSRGAMEOVER:JSR DEL:RTS
 610.MISSILE LDX#8:JSRSPLAT:LDX#16:JSRSPLAT2:LDX#16:JS
RRSPLAT2:LDX#24:JSRSPLAT:LDX#24:JSRRSPLAT
 620.HUH JSRHIT:JSRUTREE:JSRHIT:RTS
 630.HIT LDA&D0C:CMP&83:BNE DODGE:LDA&D0D:CMP&84:BNEDO
DGE:LDA&D08:AND#1:BEQ NOPUNCH:JSRFT1:.DODGE RTS:.NOPUNC
H LDA#1:STA&D0B:RTS
 640.HIT2 LDA&D0C:CMP&83:BNE DODGE2:LDA&D0D:CMP&84:BNE
DODGE2:LDA#1:STA&D0B:JSRDK:.DODGE2 RTS
 650.SPLAT JSRFW:JSR HUH:RTS:.RSPLAT JSRFW:JSRRTREE:JS
R HUH:RTS
 660.UTREE SEC:LDA&83:SBC#20:STA&83:LDA&84:SBC#0:STA&8
4:RTS
 670.RSPLAT2 JSRFW:JSRRTREE:JSR HIT2:JSRUTREE:JSR HIT2
:RTS
 680.SPLAT2 JSRFW:JSR HIT2:JSRUTREE:JSR HIT2:RTS
 690.DK LDA&D0B:BEQ DK1:LDA&D0E:CMP#&80:BNEDK1:LDA&D0F
:CMP#&2A:BEQDK1:LDA#0:STA&D0B:.DK1 RTS
 700]:NEXT:ENDPROC
 710:
 720DATA17,7,31,5,15,71,65,77,69,32,79,86,69,82,17,7,3
1,1,1,32,32,32,31,1,0,32,32,32,31,1,2,66,79,78,85,83,31
,14,1,83,67,79,82,69,31,7,1,76,69,86,69,76
```

PROGRAM LISTING 2

```
  10REMBOUNCER TEST4 BY M.STANGER
  20REMGOTO80
  30*LO."MC1"
  40*LO."MC2"
  50*LO."MC3"
  60*LO."MC4"
  70FORX%=0TO&FFC:!(&900+X%)=!(&3000+X%):NEXT
  80MODE2:!&FE00=&10700A:PROCIN
  90PROCGAME
 100END
 110:
 120DEFPROCGAME:?&70=1
 130CALL ZER:CALLSETUP
 140REPEAT:CALLGAME:CALL RES:UNTILFALSE:ENDPROC
 150REPEAT:CALLGAME:CALL SC:UNTIL?&D90=255:CALL GAMEOV
ER:ENDPROC
 160CLS:CALL FP:ENDPROC
 170:
 180DEFPROCIN
 190ZER=&1F6D:SETUP=&1D83:SC=&1FD0:GAME=&1250:RES=&20B
C:GAMEOVER=&1D6A:FP=&2130
 200ENDPROC
```

PROGRAM LISTING 3

```
  10REMBOUNCE(C) M.STANGER 1984
  20*T.
  30FORX%=0TO&FFC:!(&900+X%)=!(&3000+X%):NEXT
  40!&D94=0:REPEAT:CLS:MODE7:!&FE00=&10200A:PROCQ:PRIN
TTAB(5,23);CHR$129;:PROCP(&2BE7,23):*FX15,1
  50*FX4,1
  60REPEATUNTILGET=13:CLS:MODE2:!&FE00=&10200A:CALL&21
30:?&70=?&D70:UNTILFALSE
  70DEFPROCP(A%,B%) FORK%=A%TOA%+B%:PRINTCHR$(?K%);:NE
XT:PRINTCHR$13:ENDPROC
  80DEFPROCR(A%,B%) FORJ%=0TO13:?(&2218+16*A%+J%)=?(&2
218+16*B%+J%):NEXT:ENDPROC
  90DEFPROCQ F%=0:?&D97=0:FORI%=6TO1STEP-1:IF!&D94>!(&
2204+4*I%) F%=I%
 100NEXT:IFF%>0ANDF%<6 FORI%=5TOF%STEP-1:!(&2204+4*(I%
+1))=!(&2204+4*I%):PROCR(I%+1,I%):NEXT
 110!(&2204+4*F%)=!&D94:PRINTTAB(14,1);CHR$129;"BOUNCE
R":PRINTTAB(11,3);CHR$129;:PROCP(&2296,11):FORI%=1TO6:P
RINTTAB(1,5+2*I%);I%;:PRINTTAB(4,5+2*I%);!(&2204+4*I%)*
10;:IFF%<>I%PRINTTAB(16,5+2*I%);:PROCP(&2218+16*I%,15)
 120NEXT:IFF%<>0 PROCN
 130ENDPROC
 140DEFPROCN L%=0:FORI%=0TO13:?(&2288+I%)=0:NEXT:PRINT
TAB(5,23);CHR$129;:PROCP(&22A3,21):PRINTTAB(2,5+2*F%);C
HR$131;:PRINTTAB(16,5+2*F%);
 150REPEAT*FX11,0
 160*FX15,0
 170*FX4,0
 180D%=GET:?(&2288+L%)=D%:PRINTCHR$?(&2288+L%);:IFD%=&
7FL%=L%-1 ELSEL%=L%+1
 190UNTILD%=13ORL%=13ORL%=-1:IFL%<1FORI%=0TO13:?(&2288
+I%)=0:NEXT
 200PROCR(F%,7):VDU7:*FX11,1
 210ENDPROC
```

Making the most of BBC basic

Continuing our Walk Before You Run series from December. This month we take a further look at graphics.



OPERATION

Perhaps a word about the different modes available would be a helpful starting point. The BBC Model B has eight: labelled 0 to 7. The BBC model A, since it only has 16K of RAM, can only operate in modes 4, 5, 6 and 7. The Electron has the first seven modes (0 to 6) but no mode 7. When you first turn it on it is in mode 6.

Why bother with these different modes? The BBC and Elk have their memories arranged so that part of the 32K of RAM (this means memory that is available for us to do things with: 'RAM' stands for Random Access Memory) is used for the screen display. The more detailed you want the screen display to be, the more memory it takes. The cheapest thing, in terms of memory used, is to have no graphics at all, just text, and this is what modes 6 and 3 provide. The difference between the two is that mode 3 gives an 80-column display, while mode 6 is only a 40-column display. Thus the latter only uses up 8K of memory, leaving more memory available for programs and variables.

Once we start using graphics the memory gets eaten up at an alarming rate, especially if we use a lot of colour. But we are provided with two graphics modes (modes 0 and 4) which only use two colours at any one time. One difference between them is that the former is an 80-column text display, and the latter only forty, but the main difference is that mode 0 has very high resolution graphics while the graphics in mode 4 are not so fine ("high resolution") as those of mode 0.

You may now have realised why the BBC Model A doesn't have the lower numbered modes, as these use up more memory than it is provided with. In fact, mode 0 uses 20K's-worth, while even mode 4 uses 10K.

COLOURS

If we want more colours, modes 1 and 5 provide four on the screen at any one time (we can choose which particular four we have by selecting from a "palette" of 16), but we can't have an 80-column text display. Mode 1 provides 40-columns and mode 5 only 20, and the graphics are correspondingly less fine, Finally, if we really want to go to town, we can use mode 2 and have all 16 colours (eight colours plus eight flashing ones) on the screen at once, but we can only have a 20-column width screen and fairly coarse graphics ("medium resolution") and this uses up 20K of RAM.

LET'S GET GRAPHICAL

Now we'll choose a graphics mode and create some pretty pictures (well, a few lines. . .). We'll start off in mode 4, so that you people with a Model A can participate, but we'll still have high res graphics and a forty column screen. So the first thing to do is to get into that mode, and we may as well put the necessary statement in at the beginning of a program, to save having to type it again:

```
10 MODE 4
```

If we now RUN this one-line program the screen will clear and the cursor will appear in the top left corner of the screen. However, from now on we better call it the "text cursor", as there is another cursor, the graphics cursor, which is invisible (so as not to intrude in and spoil our pictures), but nevertheless there. After a mode change, the graphics cursor is reset to the BOTTOM left of the screen.

You will remember that if we want to PRINT at a particular point on the screen we use PRINT TAB( ) with two numbers inside the TAB brackets. These two numbers, respectively, define how far across the screen, and how far down the screen the thing we want PRINTed appears. So

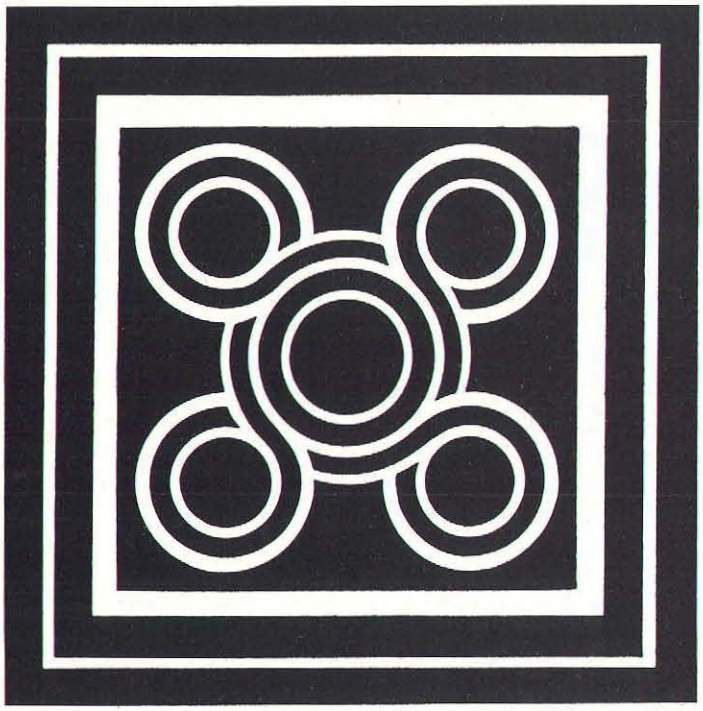
```
PRINT TAB (5,10) " * "
```

will PRINT an asterisk on the tenth line down five columns in from the left. However,

```
PRINT TAB(21,10) " * "
```

will have a different effect depending on the mode currently selected. In a forty or eighty-column mode it will behave as you would expect, PRINTing an asterisk on the tenth line down 21 columns from the left. But in modes 2 and 5, which are twenty-column modes, there is no 21st column, so the asterisk is PRINTED at the beginning of the sixth line. With text, this is not generally inconvenient, but if there was the same problem of different effects in different modes with graphics, programming them would be a real headache. Fortunately, Acorn have arranged things so that the graphics are scaled, and no matter which mode you are in, a particular pair of numbers always refer to roughly the same part of the screen. We generally call these pairs of numbers co-ordinates, just as in geometry (but don't let that worry you!).

Whereas with PRINT TAB ( ) we count from the top left along and down, with graphics we count from the bottom left along and up. The bottom-most, left-most point of the screen is labelled (0,0). This is often referred to as the origin. Moving along to the left, keeping to the bottom of the screen, the right-most, bottom-most point is labelled (1279,0). Going up the left-hand side of the screen, the left-most, top-most point is (0,1023), while



the highest pair of numbers you can have and still see something on the screen is in the right-most, top-most point of the screen, labelled (1279,1023). So the number of potentially addressable points on the screen totals 1279 × 1023, which is a staggering one million, three hundred and eight thousand, four hundred and seventeen points. Of course you can't even see this many on an ordinary monitor, let alone on a domestic TV!

Right, let's draw some lines. The middle of the screen is at around (500,500), so to draw a line from the origin (0,0) to there, we must start at the origin (which is where we are, having jut done a mode change), and DRAW to the new point:

```
20 DRAW 500, 500
```

Try rerunning our two-line program. Now the invisible graphics cursor lies at the end of the line we've just drawn, at the point represented by the co-ordinates (500,500). We could move it from there to somewhere near the middle left screen with:

```
30 DRAW 1100, 600
```

and then back to the left, and near the top with:

```
40 DRAW 0, 1000
```

This is all very well, but suppose we want to move the cursor to a new position without it drawing a line as it moves. Try:

```
50 MOVES 1279, 1023
60 DRAW 0, 500
```

and you should find that a line appears from the top left to the bottom middle which is not connected to any of the other three lines we have drawn. MOVE moves the cursor to the specified position, and the next DRAW statement starts off from that point.

PRETTY COLOURS

Now we'll change to a different mode and see if things look the same. Change line 10 as follows:

```
10 MODE 0
```

(Note: you can't do this if you are using a BBC Model A — ignore this and read on a bit further.) RUN this revised program and you will see the lines in the same position on the screen, but if you now LIST your program you will see that the text is considerably smaller. You can probably imagine the greater detail that could be incorporated into a mode 0 picture, even if this detail is not visible on the TV. OK Model A-ers, you can pay attention again, we'll try a "medium resolution" mode. Type:

```
10 MODE 5
```

and RUN. Now we have four colours to play with. There are three commands dealing with colours; one for text colours, one for graphics colours and a third command to change colours. The default colours (that simply means the colours we get if we don't set any ie by default) which we get in a four-colour mode such as mode 5 are black, red, yellow and white, which are represented by the numbers 0, 1, 2 and 3.

TEXT COLOURS

Type (directly, without line numbers):

```
MODE 5
COLOUR 1
```

and this will cause any subsequent text to be PRINTed in the colour 1 which (in mode 5) is, by default, red. The colour that the text appears in is called the foreground colour. If we want to change the background colour (that is, the colour of the screen on which the text is printed) we use the same COLOUR command but add 128 to the colour number. Thus, for a yellow background the number we want is 130 (128 + 2). So type:

```
COLOUR 130
```

and then type some text. You will see now that where you are typing a yellow background is appearing. If (as is more usual) we want the whole screen to be in the background colour then we must clear the screen so that the new colour can replace the old. The command for this is CLS — Clear the Screen. Try it.

GRAPHICS COLOURS

Graphics work in a similar way, but the command to change the colour is different and more complex. There are five options available when using graphics colour, which are selected by the numbers 0 to 5. The simple straightforward one is 0, so the command GCOLO,1 when in a four-colour mode will select red graphics, and GCOLO,131 will select a white background. Notice it is GCOL followed by zero, not an "O", and the number after the comma refers to the colour being selected. Notice also that the command to clear the graphics to the background colour is CLG- CLear the Graphics screen.

Now let's draw something in colour, the red outline of a house on a white background with a yellow roof. Type NEW to remove any program we already have in the memory then select the mode, the background and foreground colours and clear the screen to those colours:

```
10 MODE 5
20 GCOL0, 1
30 GCOL0, 131
40 CLS
```

Now move to an appropriate place and draw a square:

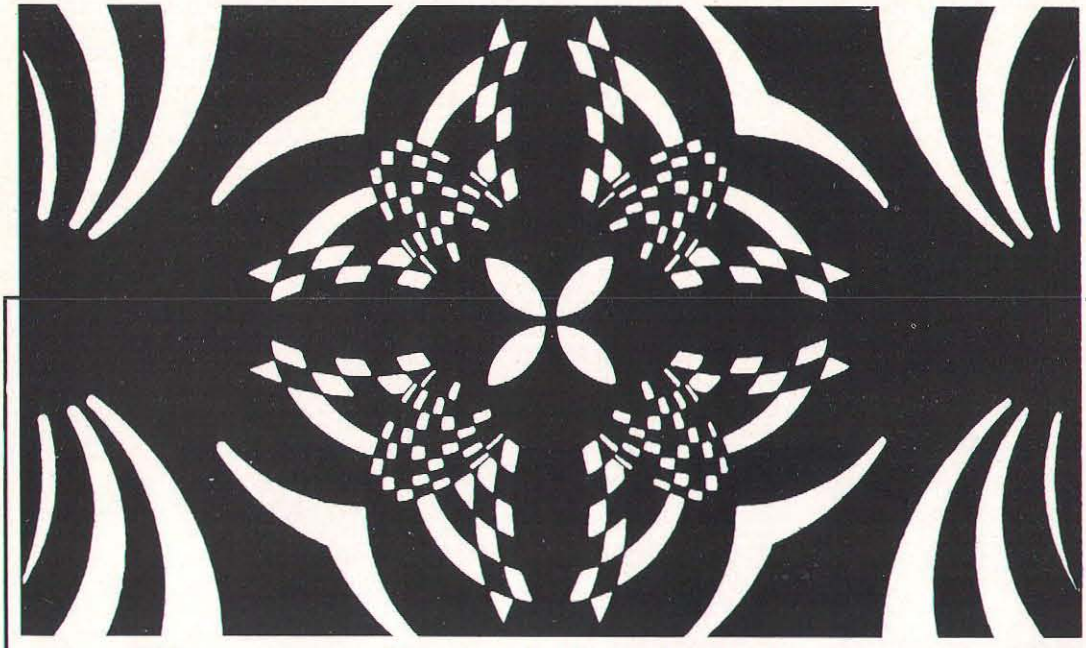
```
50 MOVE 200,200
60 DRAW 600,200
70 DRAW 600,600
80 DRAW 200,600
90 DRAW 200,200
```

Now change to colour yellow to draw the roof:

```
100 GCOL0, 2
100 MOVE 200,600
120 DRAW 400,800
130 DRAW 600,600
```

Now we can put in black windows. The instructions for one

CONTINUED OVER



window could be:

```
140 GCOL0, 0
160 MOVE 250, 400
170 DRAW 350, 400
180 DRAW 350, 500
190 DRAW 250, 500
200 DRAW 250, 400
```

EXERCISE Can you write instructions for another window and for a door? What about a chimney?

CHANGING THE DEFAULT COLOURS

Actually, black windows don't look so nice, it would be much better if we could use say, blue. But blue isn't one of the four colours available in mode 5. We could go into mode 2, of course (unless we have a model A) but we might not want to use up that much memory. The best way is this — we don't need black, so why not swop black for blue, then we'd still only have four colours.

We can do this with one of the many VDU statements which Acorn provide for various special purposes. VDU 19 is the appropriate one for this. We follow it with five numbers, the first representing the colour we've got but don't want, and the second representing the colour we haven't got available at the moment but want to use. The other three numbers are simply zeros which need to be there or strange things may happen, Acorn say they are for "future expansion". So, in this case, we don't need our black which is represented by the number zero, and we want blue, which the User Guide will tell you is colour 4.

```
150 VDU 19, 0, 4, 0, 0, 0
```

should change black or blue. Notice that once this command has been carried out, everything you do in colour 0 will be in blue.

CHANGING BACK TO THE DEFAULT COLOURS

Suppose we decide we want to use black again, rather than blue. We can use VDU 19 to change the colour back, but we have to be a bit careful. Although colour blue is referred to as colour 4 by the Beeb and the Elk, at the moment we are using colour 0 for blue since that is how we have redefined the default colour, black. Acorn refer to the colour that is actually being used at any one time as the "actual colour", but the colour that it would be by default if we didn't redefine it is called the "logical colour". In our set-up the logical colour, colour 0, is still black, even though we have redefined it as colour 4 (blue). Blue is the actual colour that is appearing on the screen. So to turn it back we must be careful to refer to the logical colour, colour 0. Thus:

```
220 VDU 19, 0, 0, 0, 0, 0
```

will turn logical colour 0 (black by default but temporarily turned to blue by us) back to black. Let's add a two second pause before that statement so we can see what is going on:

```
210 D=INKEY(200)
```

VDU19 is an important command because it allows animated colour graphics to be displayed on the computer at adequate speeds. If you are trying to move a large character (composed of several used-defined graphics) around the screen (in the way that we were on these pages in December), the technique of deleting the previously displayed character is often insufficiently quick. Using VDU 19 and defining the foreground colour of the character you want to rub out to be the same as the background colour makes it apparently disappear.

EXERCISE Try out the above idea. Take the horse and cart character from the previous article, or define a large one of your own, and move it around the screen. Incorporate a timing device (use the TIME function) to see how long it takes the computer to move the character a certain distance. Now rewrite the program so that it uses VDU 129 statements to do the animation and see how much quicker it is.

FILLING IN SHAPES

It would be nice to be able to give our house a solid roof, rather than just the outline. We can do this by using one of the special PLOT commands available in BBC Basic. There are a large number of these, and they allow us quite sophisticated control of the graphics. In fact, there are exact equivalents of DRAW and MOVE, namely PLOT 5 and PLOT 4. In addition we can, for example, make relative moves using PLOT 0.

All PLOT commands are followed by three numbers, the first representing the particular PLOT command we are using, and the other two the co-ordinates to be used in PLOTting. People who have the early Operating System will find that the only shape that they can fill is triangular, and the PLOT commands to do this are numbered 80 to 87. Those with O.S. Series 2 have some slightly more sophisticated file routines (78 to 79). We'll stick to triangular ones for the moment since we have a triangular-shaped roof to fill in. To do this we need the equivalent of a DRAW command (which is the same as PLOT 5). We use PLOT 85 (the manual explains this further). So if we amend our program as follows:

```
130 PLOT 85, 600, 600
```

we will now have a solid yellow roof.

The PLOT 85 command works like this. Any three points will define a triangular shape. PLOT 85 takes, as its three points, firstly the co-ordinates contained in the PLOT 85 command itself (in this case 600,600) and next the two previous points on the screen which the invisible graphics cursor has visited, in whatever way, with a DRAW command, a MOVE command or a PLOT command. It will then fill the triangle which is bounded by these three points.

EXERCISE: (i) Try finishing off the house by putting a garden with some flowers around it. (You might want to use user-defined characters for this). Try filling in the windows so that it look like night-time.

(ii) Practice using some of the other PLOT commands; you can draw dotted lines or PLOT single points. If you have the more recent O.S. you can experiment with the more sophisticated fill routines. Plot out the galaxy — or the solar system!



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SECOND PRO PROBLEM

Q: A letter from Mr Mxart of Dorchester was typical of several I have received recently, in addition to being one of the most frequently asked questions of late.

It concerns the 6502 second processor, as Mr Mxart explains, "...having read the 6502 second processor User Guide I am none the wiser as regards the use of Hi-BASIC. I have installed both the chips enclosed, Hi-BASIC and the DNFS, and all works well while the second processor is switched on.

However, as an avid user of Wordwise there are times when I wish to use the Beeb without the 6502 switched on — Wordwise being incompatible with the second processor. Trouble is when I switch on the Beeb without the second processor it just hangs up and no amount of key bashing will do any good what so ever.

Does this mean that I will have to change back to normal BASIC to use my Beeb as it is, and then re-change to Hi-BASIC when I wish to use the second processor?"

A: The 6502 User Guide does in fact explain what to do. In summary you can have both BASIC and Hi-BASIC fitted — ideally BASIC should be positioned on the sideways ROM socket to the extreme right (socket number 15). When you switch your Beeb on the normal BASIC will be selected and operated as per usual.

If you wish to use the second processor switch on as normal. BASIC again will have priority but now will be copied across the Tube to sit in the second processor from &8000 to &BFFF — its normal location in the Beeb which is now the I/O processor.

To take advantage of the extra memory offered by the 6502, Hi-BASIC can be loaded to sit further up the memory map. To do this you need to ascertain which socket Hi-BASIC is in. The sideways ROM sockets are numbered from 12 to 15, with 15 being the socket on the righthand side of the case. If Hi-BASIC were next to this it would be in socket 14 and is invoked using

*FX142 thus,

***FX142,14**

Hi-BASIC will be copied across and RUN.

It is possible to have only a single ROM in position and still run Hi-BASIC. To do this you need a disc and Hi-BASIC in the second processor. Now save Hi-BASIC to disc with,

***SAVE HIBASIC B800 + 4000**

The Hi-BASIC ROM can be removed from the Beeb in the usual manner thus freeing an extra socket. BASIC will now operate as usual in both the Beeb and second processor. To run Hi-BASIC simply place your Hi-BASIC disc in the drive and enter.

***HIBASIC**

BACK TO THE '50s

Q: Jay Richards of Shaftesbury has obviously been brushing up on his computer history as he has "...come across a character code called EBCDIC in my Computer Studies research. I am trying to gather some information on this coding system to complete a section on character storage. Can you help and is it possible to implement this on the Beeb?"

A: EBCDIC is short for Extended Binary Coded Decimal Interchange Code (say that fast twenty times!). It extends back to the 1950s when just about every computer company worth their salt was coming up with a different way of encoding characters. Eventually this system, IBM's, was recognised as "standard".

EBCDIC used 8 bits to define 256 characters which included upper and lower case characters, numbers and special symbols with more left over. Each type of character was represented in a particular way, for example all numbers began with 1111. However the system was very clumsy and in the 60s the ASCII system was adopted as an international standard.

To my knowledge it is not possible to implement it directly on the Beeb, but it would probably be possible to write a machine code emulator which traps the MOS.

VIA ESPANOL

Q: Mr Diaz from sunny Spain writes requesting information on the **6522,"...I am having trouble replacing an &6522 VIA data sheet** that I have lost. I would be grateful if you could provide me with a brief summary of the 6522 auxiliary control register functions. Thank you."

A: The function of the ACR will depend on the line logic.

Logic 0
Bit 7: PB7 input or output as defined by bit 7 of data direction register
Bit 6: Timer 1 in one shot mode
Bit 5: 1 MHz clock pulses as input to Timer 2
Bits 2,3,4: Shift register operation control
Bits 0,1: Latching control on Ports A and B

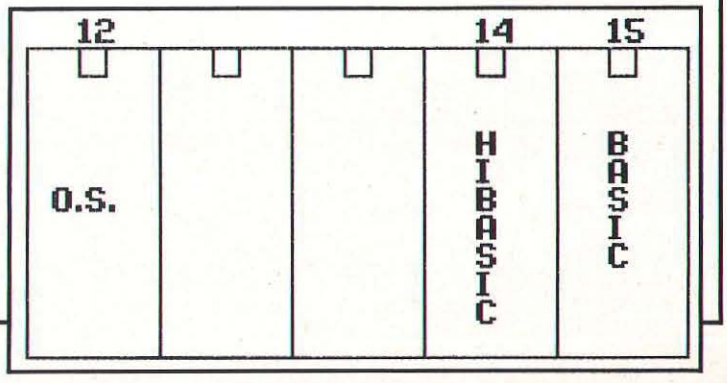
Logic 1
Bit 7: PB7 output from Timer 1
Bit 6: Timer 1 in free running mode
Bit 5: Select pulses from PB6 as input to Timer 2
Bits 0,1,2,3,4: as for Logic 0

A STAR ON THE HORIZON

Q: Jon Atherton of Altrincham has a BASIC debugging query..."I have read numerous reviews and advertisements with regards to BASIC Toolkit type ROMs in both A&B and other computer magazines. However to my knowledge none of these seem to be true debugging aids, but more simply just convenience commands — to remove spaces and REMs from a program, or to print the PROCs within a program, and so forth. My question is simply, are there any TRUE debugging ROMs with BASIC in mind?"

A: Perhaps you are being a little too harsh, as many ROMs do in fact contain debugging facilities — but I take your point, none are particularly outstanding in this respect. However a star is looming on the horizon, as Beebugsoft have just released SLEUTH. I think you will find that this bit of firmware will more than suit your needs!

Coping with HI-BASIC



Key to Keystick

Paul Chandler

Swopping keys, swopping to joysticks. It's easy with this program.



Have you ever wished that all your games programs could use the same keys for the commands or that your joystick could be used on most games programs.

Key-to-key allows you to change the keys for the various commands used in games programs. With this program you can change any number of keys you wish.

Keystick allows you to define the keys you wish to replace with the joystick movements. This program also allows the use of two fire buttons as there are now joysticks on the market which have this facility.

When typing in the programs care should be taken when typing in the machine code (lines 180-890 or 180-400), because the machine code could corrupt the program you have just typed in, if it has not been entered correctly. The spaces at the beginning of these lines may be omitted as they are just there to make it easier to understand. It is advisable to make a copy of this program on tape before it is run as it could be lost if a mistake has been made with the machine code.

When you run the program it asks you how many keys you wish to change. After you have answered the computer gives the prompt 'Old key'. At this point you should press the key you wish to change and keep it pressed until the next prompt appears. This is because the program tests each key in turn using the negative INKEY function instead of the normal GET command as this command does not test all the keys on the keyboard. The next prompt is 'New Key' and the key to replace the old key should be pressed. This routine is repeated for the number of times you specified. The machine code is then assembled. Finally the program CHAINs the title page of any game. If the program instructions tell you to *RUN the program, then line 110 should be changed to *RUN.

COMPATIBILITY

Unfortunately there are a few games that cannot use these programs. This is for one of two reasons.

The first is that the program concerned does not use the negative INKEY method of detecting key depression. If when you run the program and the keys are the same as on the original or the joystick does not work then it means that this problem has arisen. This is impossible to rectify using these programs and therefore they cannot be used.

The second problem is a little less disastrous. It is to do with the way the computer and the program uses the memory. The two programs assemble the machine code at &D00. This area of memory is usually free for tape users, unless the game to be played uses this area for some of the machine code. This is part of the area that Acorn say you should not use for your programs and for this reason I can be almost certain that all the Acornsoft games will not suffer from this problem, but unfortunately most other companies have used this area in at least one of their programs. Also if you are using discs or the Econet system then this area is used by the operating system. The symptom of this problem occurs during the loading or when the program first runs. The computer will suddenly freeze up and nothing will happen until the break key is pressed. This happens because the program overwrites the assembled code, but the machine still directs the OSBYTE commands to this area. If this happens then there is one other area of memory that may be usable. (This area has to be used in the case of discs.) This is at &B20, a section in the middle of the area set aside by the machine for the contents of the user definable keys, so the program must not use any of these keys. If the machine freezes up again during reloading then these programs cannot be used as there is no room for them in the computer.

TECHNICAL DETAILS

There are two main ways to test whether a key is being pressed. Both use the INKEY(X) function. The first way is to give the variable X a positive value, this then waits for a certain amount of time, specified by X in hundreds of a second, during this time the computer is testing the keyboard. If a key is pressed before the time runs out, then the ASCII value of the key pressed is returned. If none of the keys have been pressed a value of −1 is returned.

The other way is to give X a negative value. This enables you to test a specific key. If the key is being pressed a value of −1 is returned or else a value of 0. For more information on INKEY and the table of values for each particular key see P.273 of the User Guide.

There is one advantage of the second method, the computer can tell if more than one key is being pressed at once. For this reason nearly all of the software games use this method. As these programs are in machine code they use an OSBYTE command which does the same as the INKEY command (the actual BASIC command is directed to this OSBYTE command).

Both these programs detect when this OSBYTE command is used. For Key-to-Key the negative number is changed if the key is one of those altered at the start of the program. The Keystick program checks to see if the negative number is one of those now changed to the joystick. If so then the joystick is tested to see if it is in the correct position.

The way these changes are implemented is by altering OSBYTE vector. A vector is a number in the memory which is the address of a service routine. The OSBYTE routine uses a vector called BYTEV which is contained at the addresses &20A and &20B. The advantage of vectors is that the address contained in the vector can be changed to allow the user to replace the operating system routines with his own. This is how these two programs work.

PROGRAM DESCRIPTION

50	P$ array declaration.
60	Select screen mode.

CONTINUED OVER



70-90	Call various procedures.
100	Clear keyboard buffer ready for the start of the game.
110	Load and run the next program.
130-890	PROCASS Assembles machine code.
910-1020	PROCINPUT Allows the key changes to be made.
1040-1110	PROCKEY Tests all the keys in turn.
1130-1290	PROCSETUP Sets up P$

KEY-TO-KEY MACHINE CODE

180-220	Check for negative inkey entry (OSBYTE &81). If not bypass new routine to operating system.
230	Set up loop in Y register.
240-260	Compare key being checked with one of the keys that has been changed.
270-290	If it is then change value of key and jump to operating system routine.
300-310	Check for the end of the loop in Y. If not branch to 230.
320-340	Reload Y register and accumulator with original numbers and jump to operating system routine.

KEYSTICK MACHINE CODE

180-220	Check for negative inkey entry (OSBYTE &81). If not bypass new routine to operating system.
230-240	Check if key is the one for up movement on the joystick if it is branch to 400.
250-300	Check if joystick is in the up position using subroutine JOY (370-390).
310-330	If it is then load X and Y registers with &FF and return to operating system.
340-360	If not clear X and Y and return to operating system.
370-390	JOY subroutine-test relevant ADC channel specified by x register.
400-480	Test for down movement in the same way as up (230-360).
490-570	Test for left movement.
580-660	Test for right movement.
670-750	Test for 1st fire button.
760-840	Test for 2nd fire button.

KEYSTICK VARIABLES

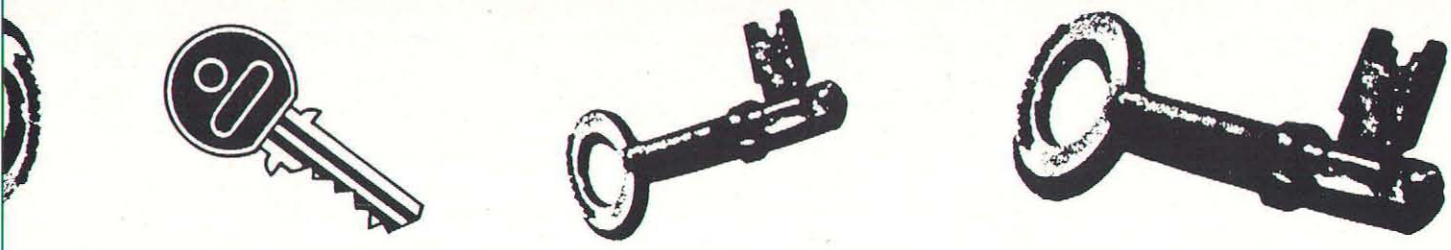
OSBYTE	Address contained in the OSBYTE vector (see Technical Details).
Address	Start address of the machine code.
EN	End address of machine code.
U	Key number for up movement.
D	Key number for up movement.
L	Key number for left movement.
R	Key number for right movement.
F1	Key number for 1st fire button.
F2	Key number for 2nd fire button.
N	Number for key being pressed.

KEY-TO-KEY VARIABLES

OSBYTE	Address contained in the OSBYTE vector before it was changed.
Address	Start address of the machine code.
EN	End address of the machine code.
NUM	Number of keys to be changed.
NE	Array for new keys.
OL	Array for old keys.

PROGRAM LISTING 1

```
  10REM Key-Key By Paul Chandler
  20
  30
  40
  50DIMP%(122)
  60MODE7
  70PROCSETUP
  80PROCSET
  90PROCASS
 100*FX15,0
 110CHAIN""
 120
 130DEFPROCASS
 140OSBYTE=?&20A+(?&20B*256)
 150FOR X=0 TO 2 STEP 2
 160address=&B20:P%=address
 170[OPT X
 180         CMP #&81
 190         BNE OUT
 200         CPY #&FF
 210         BEQ OV
 220.OUT     JMP OSBYTE
 230.OV      LDY NUMBER
 240.LOOP    LDA EN,Y:STA NENUM+NUM+1
 250         CPX NENUM+NUM+1
 260         BNE ENLOP
 270         LDX NENUM,Y
 280         LDY #&FF:LDA #&81
 290         JMP OSBYTE
 300.ENLOP   DEY
 310         BNE LOOP
 320         LDY #&FF:LDA #&81
 330         JMP OSBYTE
 340         RTS
 350.NUMBER:]
 360EN=NUMBER+1:?NUMBER=NUM:FOR Y=1 TO NUM:EN?Y=OL(Y):
?(EN+Y+NUM+1)=NE(Y):NEXT
 370NENUM=EN+NUM+1
 380NEXT
 390?&20A=address MOD 256:?&20B=address DIV 256
 400ENDPROC
 410
 420DEFPROCSET
 430N=-74
 440CLS:PRINTTAB(17,1)CHR$141;"Key-to-key"
 450:PRINTTAB(17,2)CHR$141;"Key-to-key"
 460PRINT''CHR$131;:INPUT"How many keys do you wish to
change",NUM
 470DIM NE(NUM),OL(NUM)
 480VDU28,0,23,39,6
 490FOR Y=1 TO NUM
 500PRINT''CHR$134"Old key";:PROCKEY:OL(Y)=N
 510PRINT''CHR$134"New key";:PROCKEY:NE(Y)=N
 520NEXT
 530ENDPROC
 540DEFPROCKEY
 550REPEAT UNTIL INKEY(N)=0
 560N=0:FOR X=-127 TO -1
 570IF INKEY(X)=-1 THEN N=X
 580NEXT
 590IF N=0 THEN 560
 600PRINTTAB(8);CHR$133;P$(-N)
 610ENDPROC
 620
```



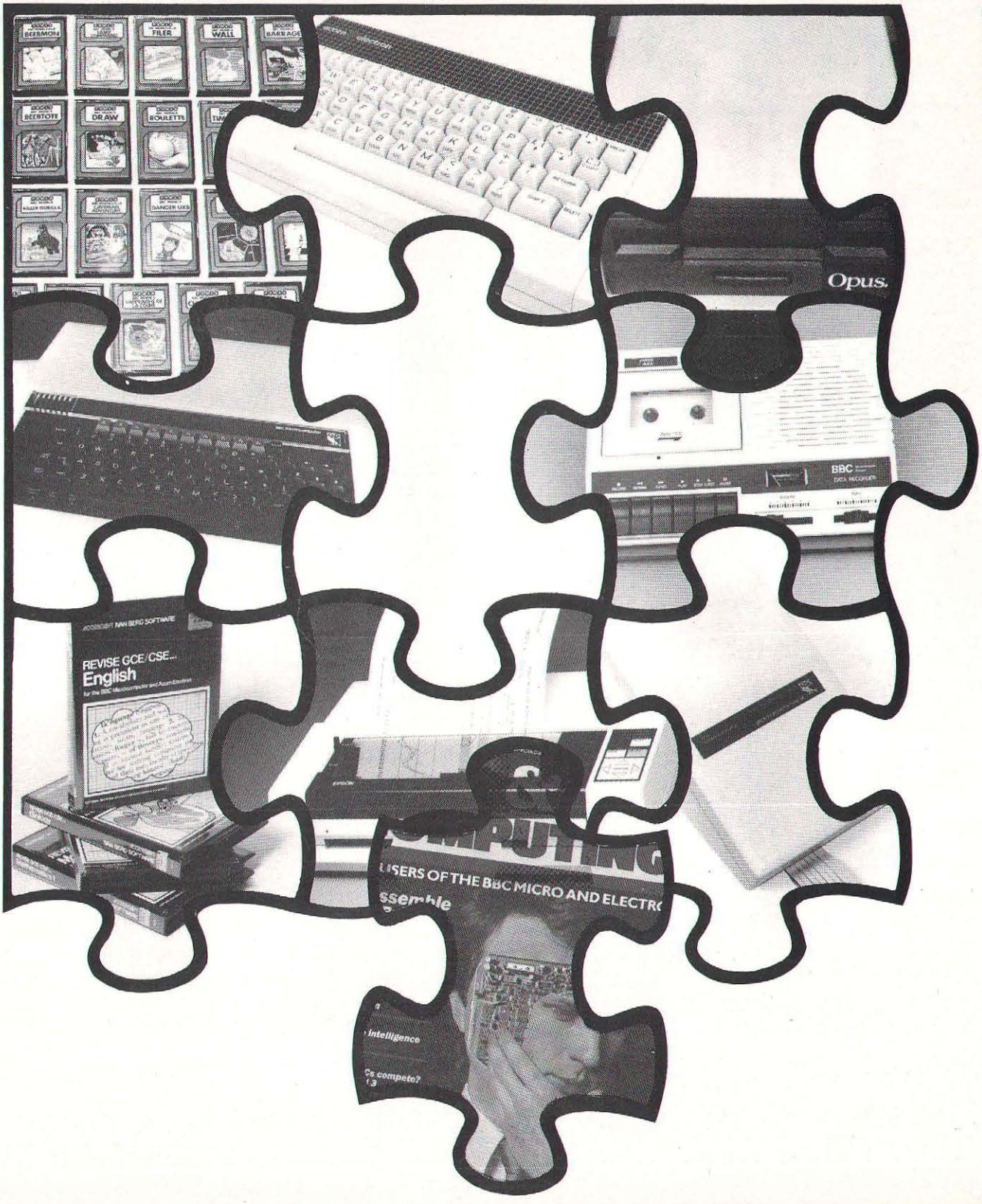
```
630DEFPROCSETUP
640FOR X=1 TO 122
650READ P$(X)
660NEXT
670ENDPROC
680
690DATAShift,Ctrl,,,,,,,,,,,,,,,Q,3
700DATA4,5,f4,8,f7,-,^,Cursor Left
710DATA,,,,,,f0,W,E,T,7,I,9,0,_
720DATACursor Down,,,,,,,1,2,D,R,6
730DATAU,O,p,[,Cursor Up,,,,,,
740DATACaps Lock,A,X,F,Y,J,K,@,:
750DATAReturn,,,,,,,Shift Lock,S,C
760DATAG,H,N,L,;,],Detete,,,,,,,Tab
770DATAZ,Space,V,B,M,",",.,/,Copy
780DATA,,,,,,,f1,f2,f3,f5,f6
790DATAf8,f9,\,Cursor Right
```

PROGRAM LISTING 2

```
 10REM Keystick by Paul Chandler
 20REM Allows games to be played with
 30REM joysticks.
 40
 50DIMP$(122)
 60MODE7
 70PROCSETUP
 80PROCINPUT
 90PROCASS
100*FX15,0
110CHAIN""
120
130DEFPROCASS
140OSBYTE=?&20A+(?&20B*256)
150FOR X=0 TO 2 STEP 2
160address=&B20:P%=address
170[OPT X
180         CMP #&81
190         BNE OUT
200         CPY #&FF
210         BEQ OV
220.OUT     JMP OSBYTE
230.OV      CPX EN
240         BNE PART2
250         LDX#2
260         JSR JOY
270         CPY #&0
280         BPL FIN
290         CPY #&20
300         BPL FIN
310.COR     LDX#255
320         LDY#255
330         RTS
340.FIN     LDX#0
350         LDY#0
360         RTS
370.JOY     LDA#&80
380         LDY#0
390         JMP &FFF4
400.PART2 CPX EN+1
410         BNE PART3
420         LDX#2
430         JSR JOY
440         CPY #&0
450         BMI FIN
460         CPY #&20
470         BPL FIN
480         BMI COR
490.PART3 CPX EN+3
500         BNE PART4
510         LDX#1
520         JSR JOY
530         CPY #&0
540         BMI FIN
550         CPY #&20
560         BPL FIN
570         BMI COR
580.PART4 CPX EN+2
590         BNE PART5
600         LDX#1
610         JSR JOY
620         CPY #&0
630         BPL FIN
640         CPY #&20
650         BPL FIN
660         BMI COR
670.PART5 CPX EN+4
680         BNE PART6
690         LDX#0
700         JSR JOY
710         TXA
720         AND #1
730         CMP #1
740         BEQ COR
750         BNE FIN
760.PART6 CPX EN+5
770         BNE OUT
780         LDX#0
790         JSR JOY
800         TXA
810         AND #2
820         CMP #2
830         BEQ COR
840         BNE FIN
850.EN:]
860NEXT
870?EN=U:EN?1=D:EN?2=L:EN?3=R:EN?4=F1:EN?5=F2
880?&20A=address MOD256:?&20B=address DIV256
890ENDPROC
900
910DEFPROCINPUT
920N=-74
930CLS:PRINTTAB(17,1)CHR$141;"Keystick"
940PRINTTAB(17,2)CHR$141;"Keystick"
950PRINT'CHR$131;"Press key for:-"
960PRINT'CHR$134"Up";:PROCKEY:U=N
970PRINT''CHR$134"Down";:PROCKEY:D=N
980PRINT''CHR$134"Left";:PROCKEY:L=N
990PRINT''CHR$134"Right";:PROCKEY:R=N
1000PRINT''CHR$134"Fire 1";:PROCKEY:F1=N
1010PRINT''CHR$134"Fire 2";:PROCKEY:F2=N
1020ENDPROC
1030
1040DEFPROCKEY
1050REPEAT UNTIL INKEY(N)=0
1060N=0:FOR X=-127 TO -1
1070IF INKEY(X)=-1 THEN N=X
1080NEXT
1090IF N=0 THEN 1060
1100PRINTTAB(8);CHR$133;P$(-N)
1110ENDPROC
1120
1130DEFPROCSETUP
1140FOR X=1 TO 122
1150READ P$(X)
1160NEXT
1170ENDPROC
1180
1190DATAShift,Ctrl,,,,,,,,,,,,,,,Q,3
1200DATA4,5,f4,8,f7,-,^,Cursor Left
1210DATA,,,,,,f0,W,E,T,7,I,9,0,_
1220DATACursor Down,,,,,,,1,2,D,R,6
1230DATAU,O,p,[,Cursor Up,,,,,,
1240DATACaps Lock,A,X,F,Y,J,K,@,:
1250DATAReturn,,,,,,,Shift Lock,S,C
1260DATAG,H,N,L,;,],Detete,,,,,,,Tab
1270DATAZ,Space,V,B,M,",",.,/,Copy
1280DATA,,,,,,,f1,f2,f3,f5,f6
1290DATAf8,f9,\,Cursor Right
```

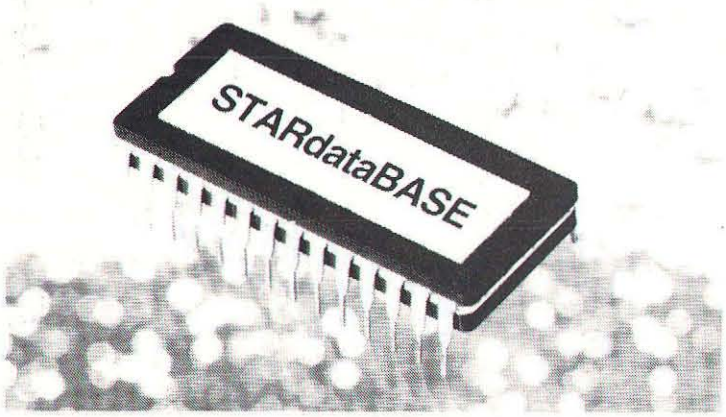
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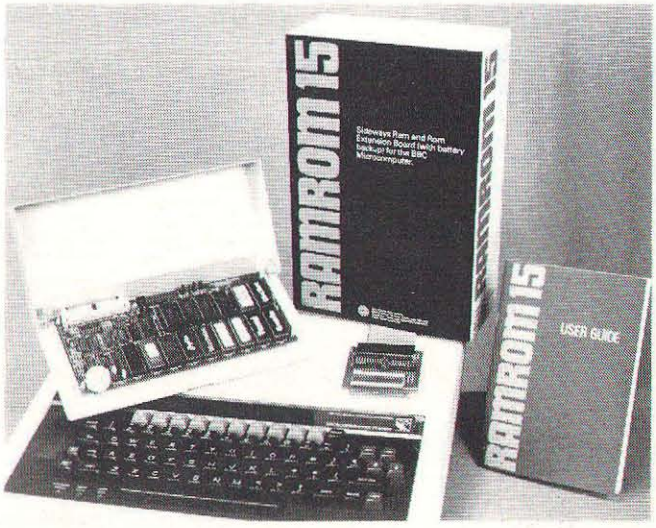
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File It with FilePlus

Gordon Taylor

Watford Electronics take on the competition with their own ROM-based business database.

Among the advantages of the Beeb are that the machine specification is so advanced and the user base is so large (over 370,000). As a result, really effective business software is still being written for it nearly three years after the launch.

Much of it is in ROM (Read Only Memory), which helps to overcome the limitation of the Beeb's user RAM size, and uses discs, which greatly increase storage capacity and transfer speed. Hence, while the Beeb is not sold with disc drives as standard, they are an increasingly popular option.

Now, alongside three ROM word processors and two ROM spreadsheets, there are at least four ROM-based database programs — StarBase, DataGem, File-Plus and Merlin. I have already reviewed StarBase (October 1984) and DataGem (December 1984) and hope to review Merlin shortly.

INTRODUCTION

Like word processors and spreadsheets in their respective applications, all database programs can be used to create many completely different datafiles. File-Plus differs from StarBase in being program, as well as menu, driven. For file creation, data entry and simple searching you drive it by pressing function keys, according to a menu of labels on the screen. However, for operations involving more complex searches and calculations, it has a simple command or query language with just 12 keywords.

File-Plus is capable of both key indexed direct (or random) access as well as of sequential access. Indeed, you can have as many indexes as you wish (eg sorted on different fields). It thus differs notably from DataGem, which is almost wholly driven by command keystrokes (as opposed to menus or command file programs) and offers only sequential access.

INSTALLATION

File-Plus consists of a single 16K ROM chip which should be installed in one of the Sideways ROM sockets. There is also a utility disc, which holds the routines for creating and using the sorted key indexes. File-Plus (like DataGem but unlike StarBase) is independent of BASIC which therefore need not be installed in the machine.

CONSTRAINTS

File-Plus, like all its competitors, operates in Mode 7. The maximum length of a text field is a single line, reduced by the two-character field tag and the leading and trailing spaces which define a field, to 36 characters. This is not as long as for DataGem (with 120 characters), StarBase (with 255 characters) or Merlin (with 900 characters).

However, File-Plus allows a program to be written, to read the whole file and then search not just one but several or all fields if necessary. (DataGem also allows all fields to be searched, by using a wildcard in the search field tag.) This feature is often useful eg when you require plenty of space for keywords, to characterise documents in a bibliographic database.

In File-Plus a numeric field can have up to 16 characters — an optional negative sign, an integer of up to 10 digits, an optional decimal point and a decimal fraction of up to four digits. Numeric data is stored in an integer (Binary Coded Decimal) format which allows unusually high precision in representing and manipulating it. This exceeds the nine figure precision (itself unusually high) of real numbers in BBC Basic.

The theoretical maximum length of a record is 2400 characters — since it can extend to up to three pages of 40-characters by 20 lines each. The number of fields per record is limited only by the need to fit them all within the maximum record length. With a full complement of maximum-length text fields, the net record length would be $36 \times 20 \times 3 = 2160$ characters. The maximum record length is also reduced by the presence of field titles/background text.

The maximum number of records is not limited by the File-Plus program if only sequential access is required. If, however, key indexed access is required, the present sort routine limits the number of records to a maximum of 5461 (sorted on one text field to a minimum depth of two characters) or 2730 (sorted on one numeric field to the implied depth of eight characters).

Due to the way that File-Plus holds the datafile, its maximum size can approach the full (formatted) capacity of the disc storage system — whether single-density floppies, double-density floppies or Winchester (see below).

FILE CREATION

After entering the program with *FILEPLUS the main of several menus, which labels the uses of the red function keys, is displayed (see Fig. 1).

Selecting f0 "Design a Form" brings a sub-menu which allows you to design your input form, using the "paint-a-screen" technique. Thus the cursor is positioned, the field title entered (in white) and f3 pressed to mark a data field. This is shown in green and you start with a two-letter field tag (a name by which it is known to the computer), followed by the required number of character-spaces and end by entering f3 again.

Data fields may be either text, marked with T's, or numeric, marked with "0's". Any number of fields may be so defined within the three pages, helped by the use of other function keys to insert and delete lines.

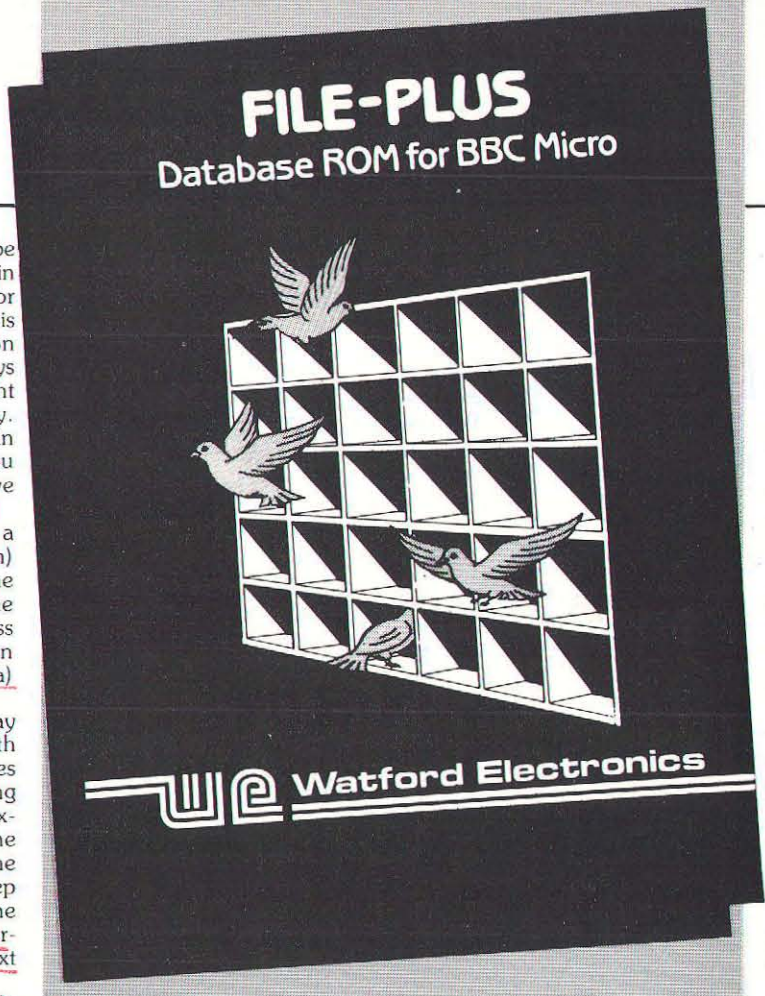
Like StarBase (but unlike Datagem), no special date type is available so dates must be entered in (YY)YYMMDD format and as numbers if you want to sort, compare and calculate with them correctly.

You can save your form design by pressing f1 when you will be prompted to enter a filename. It is very helpful to put all such forms into a separate directory eg "F" to distinguish them from other types of files. You then return to the main menu by pressing the Escape key.

File-Plus has been designed so that the datafile is saved in a way which enables it to make best use of various disc systems and allow rapid loading and saving for rapid searching. Thus it consists of a chain (or "linked list") of separately named files, each of 11K. Up to nine can fit on a standard 40-track disc, up to 18 on a standard 80-track disc and up to 29 on an 80-track disc using typical double-density recording. This list allows almost full usage of the disc space while remaining within the 31-file limit of the standard Acorn Disc Filing System (DFS).

This type of file organisation means that a file can be lengthened in place as required (by creating additional file blocks). With this scheme it is not necessary to guess how long the datafile (chain) will ultimately have to be. Thus the length is not fixed on initialisation so that it can only be increased by copying across into a larger version of the file (as with StarBase and DataGem).

Only the first file of the chain is set up initially — by pressing f5 to "Set up a New Data File" and then entering a filename. This should always include a drive number as the datafile chain can extend over any number of surfaces. It can also usefully use a directory which distinguishes it from other types of file (such as "forms" above and "indexes" and "programs" below).



The filename can best be chosen to allow a natural chain by having a name end with, for example, two or three digits. This unambiguous file specification will ensure that the file is always found, whatever the current values of the drive and directory.

After returning to the main menu by pressing Escape you can now add records. If you have just switched on, it is first necessary to select f0 "Design a Form" and f0 "Load (Form) File",input your form filename and press Escape to return to the main menu. You can then press f2 to "Add Records", whereupon you are asked to enter a (data) filename.

The screen will then display a blank of the current form (with the text fields containing spaces and numeric fields containing zeros) but not showing their extent in either case. However, the cursor will be at the start of the first field and you will hear a beep if you try to type beyond the end. The Tab key moves the cursor on to the start of the next field.

A full screen editor mode operates during data entry (so you can cursor back and just overwrite to correct an error). When you have filled the first 11K datafile, you are prompted to enter the next filename in the chain.

A File-Plus "form" and "program" is available on request that enables a new datafile to be created by importing an ASCII-formatted file from disc. This allows transfers from other databases.

PRINTED AND SPOOLED OUTPUT

Like the input, the output format is controlled by a "form". This may consist of any or all of the data fields or values, in any order and repeated if necessary. These may be modified by a program which, for example, assigns new values or calculates them from those in the datafile.

One possibility is for the output form to consist of a "form letter" containing field tags which may correspond to name and address. Such a letter may consist of up to a theoretial maximum of 40 x 20 x 3 = 2400 characters (approx 400 words) of background text, less appropriate allowance for the data fields.

Forms can also contain embedded commands for printing control, of which there are 100 different types. These enable full control of the printout such as the addition of the header, eg of field titles, to each printed page, and setting the width and length of the printed page, together with any print modes of which the printer is capable (eg normal/elite/condensed, normal/emphasised, etc). You may wish to cancel the spaces associated with the field tags, using Back Space (i.e. 08 in Hex).

Output can also be as a file "spooled" to disc, and this too is controlled by a form. One possibility is to spool out a file containing various name and address fields for merging into a standard letter. This file can be READ into, and then a series of differently addressed letters printed from, the View Word processor, by using its "macro" facility.

INDEXING

To enable key indexed access or sorted output, File-Plus has a sort utility. This is on disc (as opposed to being in the ROM) and can at present accommodate a sort file of 32K.

Since each text field has a four character overhead and depths must have even values, this corresponds to up to 5461 records if sorted on a single text field to a depth of two characters, 4096 on four characters, 3276 on six characters, 2730 on eight characters and 2340 on the maximum depth of nine characters. Numeric fields may be sorted only to their full implied length of eight characters. Hence the maximum number of records which can be sorted on one numeric field is 2730.

Creating an index, ie sorting, is possible on any single field or combination of fields (up to five). Because of the overhead of four characters per field, sorting to a given depth on two fields reduces the maximum number of records to less than half that for one field. The sort routine sorts in ascending ASCII sequence (i.e. taking account of upper/lower case) but does not allow sorting on one field at a time — even by sorting the least important first.

The sort operation may require more workspace than can be provided in the memory of the Beeb so this is sought on disc. As it can be up to 65K (at present), there is an option to write the work files to a disc separate from the data disc(s). In this case, the resulting key index file should be copied back to the data disc(s), preferably into directory "I", to distinguish it from other types of files.

You can create multiple indexes sorted on any field or combination of fields and these can be created on subsets, eg the results of searches, of the main data file. The indexes are not saved automatically with the main datafile nor maintained up to date (ie with later entries included in the sorted order) as in the Merlin database.

SEARCHING

Searching may use key indexed access, in which case you have to load additional code into RAM and then enter the index filename. Pressing f6 from the main menu will then enable key indexed access and pressing f3 will enable "Display Records" which executes an inbuilt default program.

You are then asked to enter the name (tag) of the field you wish to search on, followed by — "less than", "equal" or "greater than" and a search string or number (in the first sorted field). This can be of any length (up to the maximum of 36 text charac-

CONTINUED OVER



Fig. 1

FILE-PLUS ROAD MAP

Main Menu	Sub-Menus
f0 Design a Form	f0 Load (Form) File
	f1 Save (Form) File
	f2 Page 00
	f3 Mark Field
	f4 Delete Field
	f5 Insert Line
	f6 Delete Line
f1 Program Entry	f0 Load (Program) File
	f1 Save (Program) File
	f2 Page 00
	f3 Insert Character
	f4 Delete Character
	f5 Insert Line
	f6 Delete Line
f2 Adding Records	f0
	f1 Add Record
	f2
	f3
	Ctrl f4 Print Record
	Ctrl f5 Spool Record
	f6
f3 Display Records	f0 Skip this Record
	f1 Add this Record
	Ctrl f2 Delete this Record
	Ctrl f3 Update this Record
	Ctrl f4 Print this Record
	Ctrl f5 Spool this Record
	f6
f4 Execute a Program	
f5 Set Up a New Datafile	
f6 Index File Closed (Load ASSIST, press f6 to open)	
* Execute a Star Command	
	ESC Return to Main Menu



ters or a 14-digit number) and is independent of upper/lower case.

Searching defaults to sliding (ie it can skip any number of leading characters in the field) but it is much quicker if padded with wildcards to the correct position in the field. Wildcards may also be embedded within the search string.

When using key index access, searching may be repeated in order to refine the subset. The in-built default program causes the record containing the target string to be displayed. From there it may be added (ie replicated), deleted, updated, printed or spooled. If the datafile or subset contains more than one record, they may be stepped through by pressing f0.

If no key index file is available for the target field, searching is still possible on text fields, using sequential access. (Numeric fields require COMPARE in this case, see below). This is particularly valuable, as the number of records is then limited only by the capacity of the disc drive(s).

Sequential access searching is still notably fast with File-Plus, since it uses the Beeb's OSFILE command to locate the 11K datafile blocks in one go, whereupon searching proceeds at in-memory speed. (This is very similar to DataGem — which has only this method of searching.) Furthermore, since you have to enter the data filename before using sequential access, you can enter one part-way along the chain (which may correspond roughly to the date when it was entered) in order to further speed the search.

Also, unlike StarBase and DataGem, you do not suffer from the time taken to search the full (initialised) datafile, even before it has been filled up. Even so, it takes only 30 odd seconds to search 100K when using the Acorn 0.90 DFS which is some three times as fast as StarBase.

As with other database programs (but to a lesser degree, because of the reduced number of load/read operations), the search time can be reduced by using a faster DFS such as the Watford 1.3 or the Acorn 1.2 (as used in the DNFS).

In a database driven by a user-written command language file, or program, a sequence of operations may be initiated by a single key (once the program file is loaded). This is especially worthwhile when it is long enough to be difficult to key in interactively, ie via menus, and it is needed repeatedly, eg each month, each week etc. A typical example would be automatically totalling the sales of a range of products.

The main difference between File-Plus and its competitors is that it is also capable of being driven by "command files" or programs which may also be saved. Such programs can occupy up to 40 x 40 character lines = 1600 characters, spread over two pages and each line may contain more than one statement, separated by colons — as with the BBC BASIC. (DataGem is largely "command-driven", but the length of command file that can be saved is limited to only 256 characters and it cannot be edited). The lines are unnumbered but two letter labels are allowed and the File-Plus Query Language, FQL, has 12 keywords — see Fig. 2. These include SEARCH for text strings (with conditional and unconditional looping eg to examine a series of records) then READ, which may be followed by ASSIGN, COMPARE (numbers), DISPLAY, UPDATE, PRINT and/or SPOOL.

From the main menu you can press f1 "Program Entry" and then either type in a new program or load a previously saved program. Then you can return to the main menu by pressing Escape and press f4 to "Execute a program".

You can have as many programs (and forms and indexes) as you like, saved under different filenames, which can operate on the same (or different) datafiles, but only one at a time. Within this limitation, File-plus can be used to set up custom database systems.

It is also possible to put the names of frequently needed files eg indexes, datafiles, forms and programs (followed by RETURN) onto function keys, which can be invoked from within File-Plus by pressing Ctrl-Shift-Function Key. These settings can be saved using * SAVE filename 0B00 0BFF — this being the function key buffer area.

If different directories "F" and "P" are used, the forms and programs that go together can use the same filenames. This is also true for "I" indexes and even "D" datafiles.

Program files can be printed out from within File-Plus, using *FX 3,0 * LIST (filename). It may also be possible for form files but they contain embedded control codes which may upset the printer. Form and program files can be printed out from outside File-Plus, using Ctrl-B, *LIST or *DUMP filename, Ctrl-C.

CALCULATIONS

The four standard arithmetical operators + − * / are provided, together with unary minus. All six Boolean comparison operators =,<>,<,>,<=,>= are also provided, together with the logical combinations operators AND and OR. The operations normally follow a precedence table but this can be overridden by using brackets.

Either a number or an expression may be ASSIGNed to a numeric field, while a text string may be ASSIGNed to a text field, overwriting the old value in each case. The new value can be written back to the datafile using UPDATE. All six Boolean comparisons may be tested for on numeric fields (using COMPARE), whereas only "equals" may be tested for on text fields.

File-Plus has 10 (numeric

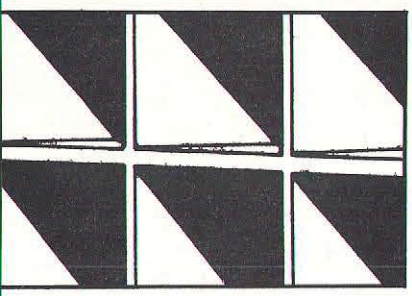
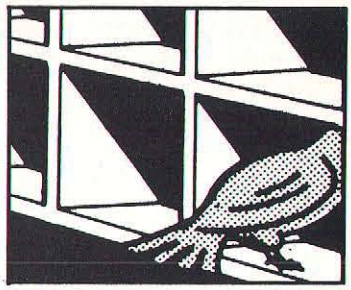


Fig.2
FILE-PLUS QUERY LANGUAGE KEYWORDS

ASSIGN	text, number or expression to field
COMPARE	field value with text string or number & set flag
DISPLAY	last record READ from datafile, using current form
END	program
GOTO	label
IFF	(if flag false) then goto label
IFT	(if flag true) then goto label
PRINT	this record, using current form
READ	next record from data file
SEARCH	datafile for text string in field
SPOOL	this record to file on disc, using current form
UPDATE	last record READ from datafile with this



only) memory or file variables, which may be used to hold, for example, totals across records etc.

SECURITY

File-Plus has no provision for using passwords to limit access (unlike Starbase and Data Gem). In any case (like StarBase), File-Plus datafiles can be read very simply using * LIST, * TYPE or * DUMP.

COMPATIBILITY AND ROBUSTNESS

File-Plus works with the Acorn 0.90, Watford 1.3 and Acorn 1.2 DFSs. It also works with the Watford Double Density Disc Interface which allows a database of around 1.4 MB with twin double-sided 80-track drives, and should therefore work with most others.

A chain of File-Plus 11K datafiles can also be stored on a Winchester (hard) disc, with the maximum number being determined by the disc filing system (sometimes called a Winchester Filing System — WFS). Several of the WFSs divide the total disc surface into a number of Acorn DFS compatible "pseudo-surfaces", each of which can hold up to the standard 31 files.

It thus seems unlikely that it will also be compatible with the new Acorn Advanced DFS — as used both with double-density floppy discs (on the Electron Plus 3 and ABC Personal Assistant) and with the new Winchester discs. Indeed, all File-Plus filenames can consist of up to 18 characters in total, hence there is ample space for drive numbers (for DFS), directories, sub-directories (for ADFS), as well as a name of up to seven characters.

File-Plus works with PAGE = &1900, as with the Acorn DFS in operation. Thus it may also work with only the Econet Net Filing System in operation, but not both the DFS and NFS at once (unlike StarBase and DataGem). It will not work from the 6502 Second Processor.

File-Plus includes no fewer than 38 system (help) messages, all in plain English, which inform you about most eventualities. Upon request you can obtain a BASIC program to reset the pointers of any File-Plus datafile that has become corrupted.

MANUAL

The manual, with its 73 A5 pages, may be described as adequate. The text has been daisywheel printed and the pages are held together with an open-flat plastic spine.

Most of the features, and the File-Plus Query Language, are described well enough and in a logical order. Several examples are also included of output forms (some with embedded commands for printing control) and of programs written in the File-Plus Query Language. These provide the only illustrations of some of the finer points, despite the provision of a seperate section on Hints and Tips. However, there is a very useful section expanding on the system (help) messages.

GROWTH POTENTIAL

All databases tend to grow with time — in record length, in number of records, in complexity of search and calculation and in the variety of output formats.

To add a field to a File-Plus record you just add it to the current input form, then read each record, delete it from the file and re-add the new version to the file. The maximum net record length is amply large for most purposes — at up to 2160 characters over three Mode 7 pages.

File-Plus allows the datafile size and hence the number of records to be increased in a particularly easy fashion by naming more files as required.

However, if key indexed random access is required, the File-Plus sort routine limits the number of records per file (to 5461 records if sorted on one text field to a depth of two characters or 2730 if sorted on one numeric field). This limit could be raised by modifying the sort routine since it is on disc and uses another disc for temporary workspace. For example, it could be at least doubled (though this would require an 80-track disc).

Unlike several of its competitors, the number of records per file is not limited by factors within the ROM (eg Starbase to 4096, Merlin to 4000, DataGem to 5110). In priciple this means that in sequential access, it could exceed even CP/M database programs (which typically allow up to 32,000 but require a Torch or Acorn Z80 Second Processor). The only other database program offering a maximum number of records of this order for the single-processor Beeb is the disc-based DataMinder (26,600 — and that with key indexed access).

File-Plus can work with 40 or 80-track (floppy disc) drives, one, two, three or four surfaces and single or double density recording — permitting datafiles of up to 1.4 MB. It also seems likely to be able to work both with most of the non-Acorn Winchester Filing Systems and with the recently announced Acorn Advanced DFS which could allow datafiles of 10 MB or more.

The ability to store programs means that complex procedures can be carried out on a regular basis with significantly less risk of error or of corrupting the datafile than if the database program were only menu-driven.

The output formats, defined by forms and programs, can be printed out in any fashion of which the printer is capable, and they may be increased virtually without limit.

CONCLUSIONS

File-Plus is not quite as versatile as StarBase or DataGem in the designing of the output form, but it allows a maximum record length more than double that of StarBase.

The File-Plus datafile organisation is much better than either StarBase or DataGem (in that it can be extended in places later) and, like DataGem, can make full use of all four floppy disc surfaces permitted by the Acorn DFS and probably of most double-density and Winchester filing systems as well.

Although sorting/indexing is less easy than in StarBase it can be to a greater depth, and multiple indexes on any fields are possible, which can give much faster access than with DataGem.

In sequential searching, File-Plus is much faster than StarBase and comparable with DataGem.

As well as being capable of being menu-driven for most simple operations — searching, printing and spooling — File-Plus can be driven by command files or programs which can be saved. This enables more complex operations including comparison and calculations to be carried out easily and without error as often as required. Custom systems can therefore be set up with it.

By using forms to control the output format for printing or spooling, File-Plus allows as much flexibility as StarBase or DataGem. All three can produce a short form letter without requiring a word processor and can produce names and addresses etc for merging into a letter in View, using the macro facility.

Overall, File-Plus is slightly less easy to use than StarBase on a casual, infrequent basis but much more capable and easier to use on a repeated basis (due to the longer records, faster sequential searching and saveable programs).

File-Plus is slightly less capable than DataGem but quicker and much easier to use (due to the indexed access and longer, editable and saveable programs). It also has extensive meaningful system (help) messages and compares very well in value for money.

File plus costs £49.45, including VAT, and is available now from Watford Electronics, 33 Cardiff Road, Watford, Herts. Tel: Watford (1923) 40588.

Software Reviews

Reviewers this issue: David Abbott, Jonathan Evans, Peter Rochford, Shingo Sugiura and Brian Timmins.

Title West
Publisher Talent Computer Systems
Machine Model B
Price £6.95

Of late I haven't played many adventure games so when West arrived for review it was received with great enthusiasm. I wasn't disappointed either as it makes a refreshing change from the dungeons and dragons scenarios of so many other adventures I have played in the past.

No witches and dwarfs here, only gunfighters and crazy indians. West is a text adventure set in a town in the badlands of the wild west where your task is to seek out a gang of bank robbers. You must outwit and outshoot them and then find their stolen loot before making your escape from the town.

When you start out you are armed with your six gun with which to protect yourself and it's not long before you are called upon to use it. Events in West happen in real time and you have to type "shoot" pretty fast to stay alive for long.

Wandering around the town is full of nasty surprises. Rattlesnakes slither past, robbers shoot at you and believe it or not you get challenged to a game of pontoon if caught with a pack of cards. This is a game within a game and certainly adds to the enjoyment.

Like all good adventures this one requires a sense of humour to play it. For example, this idiot when told "East you can see a cherry tree" pressed E for east and was then informed "You have just bumped your head on a low branch of a cherry tree and fallen off your horse." Berk! I had forgotten I was riding a horse!

Incidentally, I discovered during one particularly frustrating session with this adventure that it responds to foul language. I won't reveal what happens as it will spoil it for those who buy the game, but be assured you are punished severely for your sins!

There are some 130 locations in West for you to explore and the game has a vocabulary of 300 words and about as many phrases. There is no "dictionary" provided at all with this adventure and it is left up to the player to come up with the right commands.

Descriptions given of locations are very comprehensive and on some occasions are as long as half a screen-full of information.

There is a save game facility which can be invoked at any time but which I found rather slow. Also I should mention that this game takes an age to load as it is a massive 6F hex blocks long. This unfortunately prevents it from running on disc which is a bit of a pain for those well heeled enough to own disc drives.

I found this game really enjoyable right from the word go. It is challenging, fun and witty which are all good ingredients for an adventure. There are plenty of good descriptions and plenty of surprises too. Definitely worth buying. **P.R.**

Ratings Table:

DOCUMENTATION	90%
VALUE FOR MONEY	85%
OVERALL	85%

Title Savage Pond
Publisher Argus Press
Machine Model B
Price £7.95

This arcade game is rather fun and different from any I have seen before. You use keys or joystick to control a tadpole swimming around a pond eating (I presume) amoeba and other goodies such as juicy worms.

The movement is snakey like, ie the tadpole is in constant motion and you must change its direction to avoid disaster. The hazards appear to be some kind of plant on the bottom which grabs you and a vicious lobster-like creature that occasionally races after you (you must hide in the bank until it leaves). If you do too well you also get nasty looking jelly fish at the top of the pond to avoid.

The graphics are very good, the game fun and original and particularly appealing to young children.

The aim of the game is to build up a colony of frogs without being killed off by all the hazards of the pond. **J.E.**

Ratings Table:

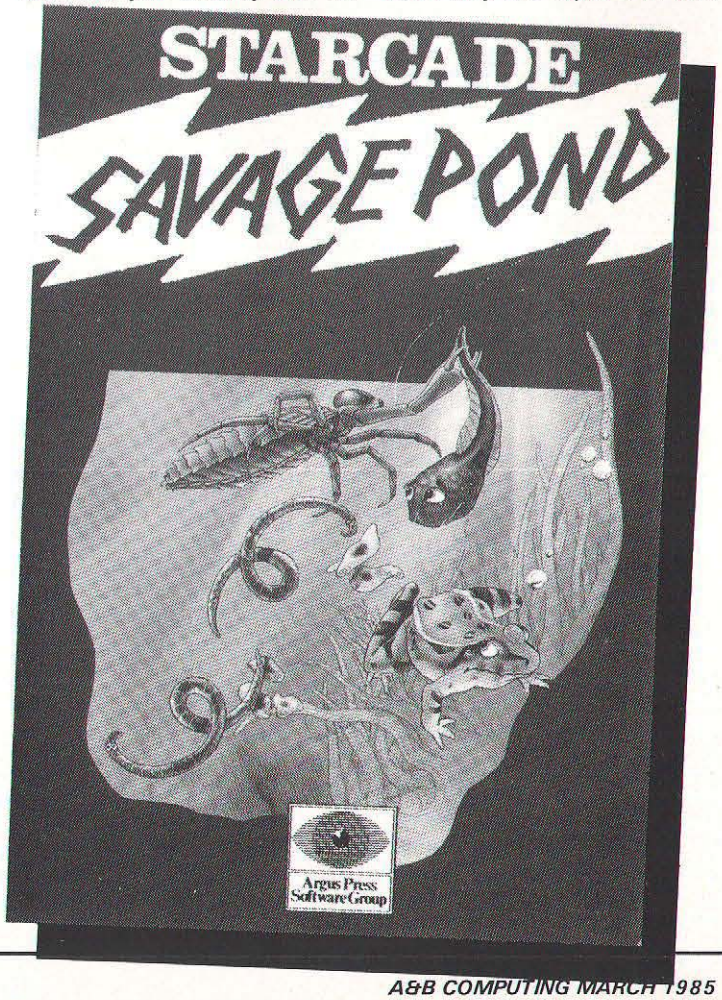
SOUNDS	60%
GRAPHICS	85%
DOCUMENTATION	70%
VALUE FOR MONEY	70%
OVERALL	75%

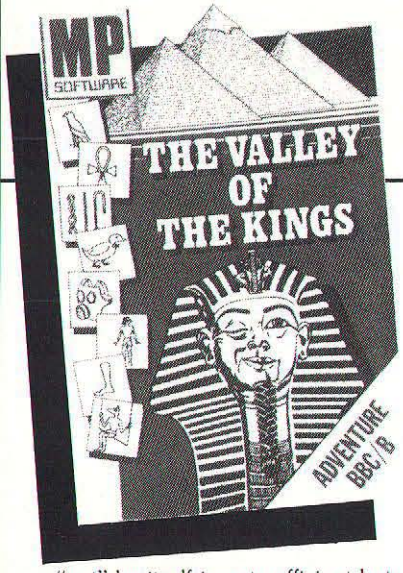
Title Valley of the Kings
Publisher MP Software
Machine Model B
Price £7.50

"Alas you are in the tomb of death where your soul is doomed to wander forever". A fancy way to say you have just snuffed it, but dead you certainly are. So ended all my attempts at this real time adventure game from MP Software.

The plot is based in Egypt where you have to explore the lost pyramids of Kacalud and find the legendary golden mask. I found the pyramids and even a golden sword, but no sign of the golden mask. In fact, as I needed to return the sword to a tent in the archaeologists camp in order to score 20 points, and I haven't managed to do this, I haven't yet managed to score a point before dying. Not very good in a game that awards 20 points for each valuable artefact, a bonus for finding the mask, and a possible score of 500 points!! I obviously have a long way to go.

The game runs logically but is a little fussy about the words. In a number of places "go in" is not acceptable, only "enter", and when only one object is in view





"get" by itself is not sufficient but "get object" must be used in full. When a game is sufficiently puzzling in its own right I find such restrictions on terminology annoying.

MP Software describe the game as a real time adventure. This means that the game will continue to play when it is waiting for a command to be entered. The only evidence I have seen of this is the occasional "time passes" output whilst I have been thinking. Time can be halted and restarted by using the escape key and space bar respectively.

The screen is split into two parts. The top gives the computer responses and descriptions, while the bottom displays your input. This latter section is only a few lines deep so it is impossible to look back over more than three or four moves — map making is therefore essential.

The computer outputs, which are virtually instantaneous, are in different colours for descriptions, items found, and other responses, which makes for an attractive display. As with most BBC adventures this is text only, but personally I don't rate that as a minus point.

Only one grumble — "HELP' is replied to with "You must be joking, nobody tells me what's going on around here so why should you get to know." Perhaps expecting a constructive reply was asking for too much?

D.A.

Ratings Table:

DOCUMENTATION	60%
VALUE FOR MONEY	80%
OVERALL	70%

Title **Moneywise**
Publisher **Squirrel Software**
Machine **Model B/Electron**
Price **£9.95**

I am the sort of person who opens a bank statement three days after it has arrived and peeps nervously at the bottom line to check that I am not (badly) overdrawn. Also I have never felt the need to prove that my home computer is "useful" before settling down to enjoy a game with a good conscience. In short, I am not the sort of person that home accounts programs were made to sell to, so I have had to imagine that I wanted such a program in order to evaluate this one.

Whilst Moneywise has some promising features it also has some silly ones, some bugs and inadequate documentation (though, typically, that which accompanied the review tape looked provisional).

Using a home accounts program requires regular updating of files so use with a disc system is preferable, and according to the documentation the program will automatically transfer itself to disc on request. Each file you create will keep records of two accounts, apparently for a period of 12 months, though this limit is not indicated in the documentation. The use of Mode 4 displays is sensible, with a compromise between legibility and the amount of data that can be present on the screen. I also liked the use of different coloured backgrounds to let you know which account you were working on etc. Each account is organised in monthly records. Every heading you enter (eg salary, gas bill) is copied throughout every month. This has the advantage that you can copy a regular debit or credit from one month to the next by aligning a pointer and pressing COPY. There is also provision for annual analysis by each of these categories, including bar chart displays.

Now the weaknesses. The categories of debit/credit assigned to one of your two accounts are also copied to the second account on the file — which is plain daft. There is no indication of which account is being processed in the annual analysis — perhaps a combination fo both!

Whilst each page may be dumped to printer, there is no opportunity to tell the program which (non-standard) ASCII code the printer uses for the £ sign. It uses the BBC's VDU display code which produces a quotation mark on most printers. Looking also at the sloppy documentation, I wonder why the company did not finish the thing off properly before sending it out.

J.E.

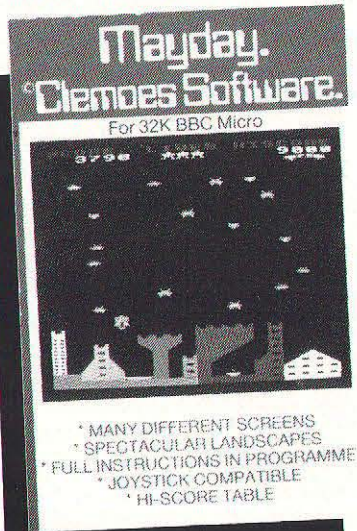
Ratings Table:

GRAPHICS	70%
DOCUMENTATION	40%
VALUE FOR MONEY	40%
OVERALL	50%

Title **Mayday**
Publisher **Clemoes Software**
Machine **Model B**
Price **£6.95**

Most of the games released these days are of a pretty good standard. Unfortunately Mayday is not one of these. It is no more than a souped-up lunar lander with different screens to land on.

A mothership passing along the top of the screen releases a landing module at your command. This drifts down the screen at a constant rate unless you slow it with your retro-rockets.



Left and right controls enable you to land on one of two areas, the smaller being more difficult but earning more points. On the way down you have to avoid horizontally moving asteroids, whose impact is lethal.

Having landed successfully, the module re-launches itself and you have to try and re-dock with the mothership. Only this time, as well as avoiding the asteroids, you also have to avoid alien ships and the bombs that they drop. You can shoot vertically to try and clear a path on your way up.

Control of the landing module is limited to left, right and reduced thrust on the descent, and only left and right on the ascent. This makes the interaction with the game rather limited, and leaves too much to chance.

The graphics are average but at least move smoothly. Sound effects are minimal.

The instruction sequence at the start typifies the below average quality of this game. When asked if the player wants instructions, pressing "Y" gives a full YES response, but then requires the carriage return key to be pressed to act on the entry. The instruction sequence itself has spelling mistakes, and is not particularly well presented. **D.A.**

Ratings Table:

SOUNDS	40%
GRAPHICS	50%
DOCUMENTATION	40%
VALUE FOR MONEY	50%
OVERALL	45%

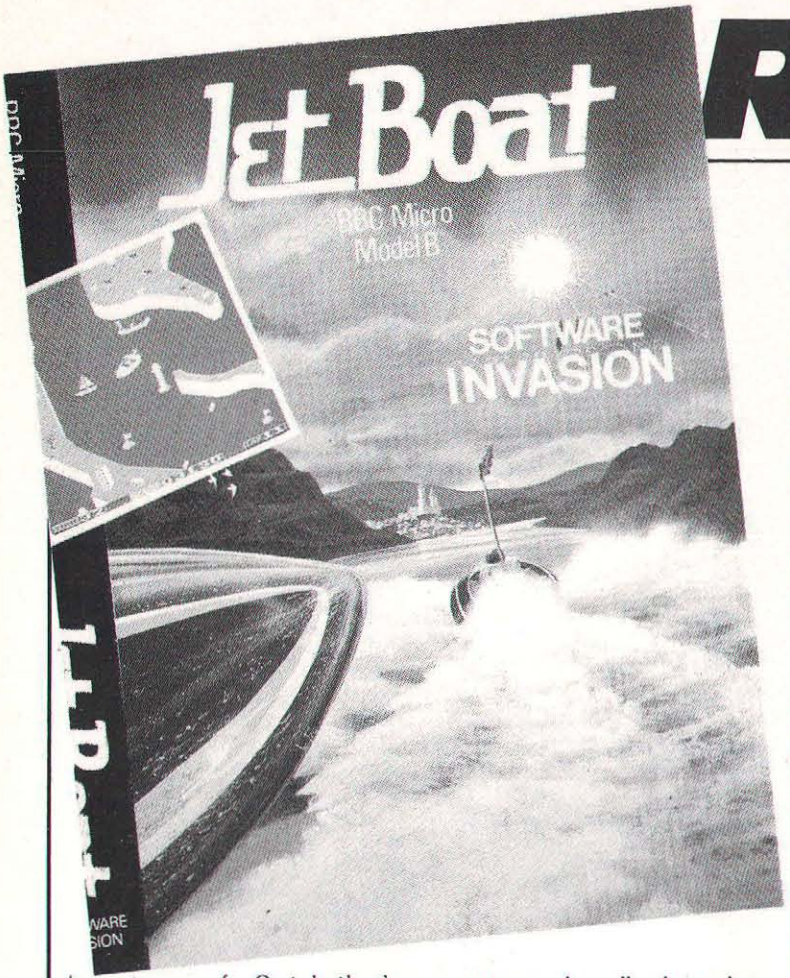
Title **Jetboat**
Publisher **Software Invasion**
Machine **Model B**
Price **£9.95**

Following up their epic 3D Grand Prix, Software Invasion have gone for another three dimensional type game. This time the player is racing a Jet Boat against time.

The loading procedure is long with lots of graphics

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(courtesy of Quicksilva's Beebart). The best feature is that you can redefine the keys for left, right and accelerate, choosing any keys which suit you best.

The interminable loading time (interesting block countdown from &FF) is worth every second. A screen full of Jet Boat scrolls sideways to reveal a twisting and turning course of blue water through a variety of landscapes, walls, buildings, farms and castles. The ready sign disappears to reveal the Jet Boat on the starting line.

It's captained by a sporty looking sprite but it's you that has to come up with the fast reactions and judgement to guide Jet Boat through the course.

There is a good mix of bends, wide passages and slim straits to test your skill. As each lap is completed within the time limit (if you don't make it the game ends and the high score table appears) more objects appear along the course and make things pretty hairy. The sea monsters and sandbanks push to the limits of concentration.

The game is compatible with joysticks but I preferred the fine touch of the keyboard control. If the boat gets stuck on a bit of land (you can plough your way across land and through buildings if you really want to!) it is best to get off by the quickest route rather than continue on your current heading. It doesn't matter how much of the boat is touching, you just grind to a near halt.

The action is very smooth, impressively so considering the amount of landscape and features that go whizzing by the Jet Boat as it accelerates away. Sound is OK and can be switched on and off as wished. You also get a freeze option. Quite a game, original, challenging and nerve pinching.

M.W.

Ratings Table:

SOUNDS	75%
GRAPHICS	85%
DOCUMENTATION	75%
VALUE FOR MONEY	75%
OVERALL	85%

Title Crazy Caves
Publisher Silversoft
Machine Model B
Price £7.95

This is a small adventure by commercial standards but quite well constructed and might appeal to those daunted by the vast programs of the Level 9 class.

At least you feel you have a chance of solving one like this. Although I did solve it, the final steps were unsatisfactory, allowing repetition of earlier moves. I was left wondering whether this was a bug in the program and if I had missed the solution intended by the author.

The screen design makes sensible use of Mode 7 colour — consistently associated with different screen messages — without any confusing windowing. The game itself has relatively few locations and short descriptions, since no compression is used.

However, there is a rather nice feature in that one encounters a shop with a number of useful items, each of which requires the payment of a treasure. You generally only have one available so you must buy the right item to solve the next puzzle to get another treasure and so on.

While entertaining, the program has an amateurish feel to it — essentially a rather long magazine type program and definitely not approaching the kind of Acornsoft, Level 9 etc class.

J.E.

Ratings Table:

DOCUMENTATION	55%
VALUE FOR MONEY	50%
OVERALL	55%

Title European Knowledge
Publisher Micro Power
Machine Model B
Price £6.95

European Knowledge gives you the chance to put your knowledge of Europe to the test as you might gather from its title. The program draws a hi-res map of Europe and then sets a series of questions for you to answer.

First, one of the countries is singled out by the program and drawn in an inset in the top left-hand corner of the screen. A flashing arrow then points to its location on the main map and you are asked to identify which country it is.

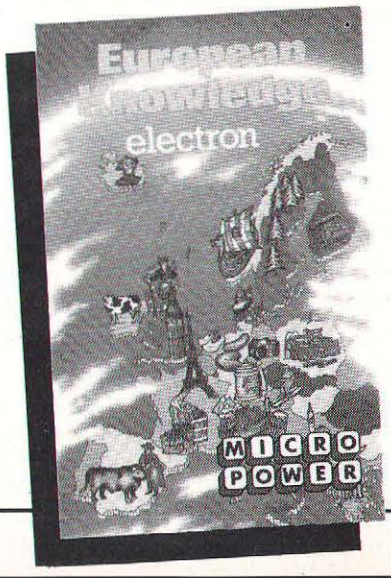
Having identified the country correctly, you are set four questions on such subjects as its population, currency, language, famous people or major towns and cities. You are given a choice of answers for each question and select with a single key press the one you think is correct.

Before the test starts you set the degree of difficulty you want to work to. This sets the time allowed to answer each of the questions. Should you fail to answer in the given time or in fact give a wrong answer you are told what the correct one is.

Forty questions are set in each session and at the end your score is given as a percentage. It is also possible to check your score at any time during the test too.

The overall presentation of this program is very good. It is very user friendly with no glaring nasties. I tried it out on several friends including some young children who were not that familiar with computers and they found no problems and in fact thoroughly enjoyed themselves.

One point that was mentioned by a few people was that the



flashing arrow used to point to the country sometimes lead to a bit of confusion. I have to agree with that too and think that a better method could have been adopted.

In conclusion this is a very good program of its type but I feel that it is rather expensive for what it does. In a school where it would be used by many pupils it is obviously worthwhile, but for home use it is rather limited as after being used once or twice it then becomes redundant.

P.R.

Ratings Table:

GRAPHICS	65%
DOCUMENTATION	70%
VALUE FOR MONEY	50%
OVERALL	55%

Title	**Laser Reflex**
Publisher	**Talent Computer Systems**
Machine	**Model B**
Price	**£7.95**

Laser Reflex entrusts you with the task of guarding a remote space station containing silos of liquid oxygen for refuelling space craft. As you might well expect this station is under attack from a marauding alien ship, hell bent on making off with your precious cargo.

Waves of drone ships are sent down to attack you and you must defend yourself using your deadly laser cannon. The unusual thing about this cannon is that it is fired at a giant mirror on one side of the space station and the laser bounces off at angle dependent upon the distance of the cannon from the mirror.

The cannon must be refuelled from time to time and to do this is must be moved away from the mirror with a resultant loss of effective fire power.

Initially your space station is protected by a shield but this is soon breached by the constantly attacking waves of drones swooping down from the mother ship. When the shield is penetrated the drones construct pipes on top of the oxygen silos and siphon away the fuel. Once all four silos have been drained you lose a life until all four lives are lost and the game ends.

Points are scored for shooting down the drones in the advanced attack wave which comes at the end of each level.

The graphics in this game can best be described as messy and result in a rather confusing display. I found that the position of the laser cannon was difficult to ascertain sometimes against the background of the space station silos. I use a hi-res monitor but would suggest that anyone using an ordinary domestic TV will find this game rather awkward to play. Sounds can only be described as adequate, so definitely no awards in this category either.

The game can be played with user definable keys or by joystick operation and features the ability to switch off the sound or adjust the volume to any one of three levels. There is a high score table but it will take some pretty good shooting to ever see it as the qualifying level is set rather high.

Nothing about this game really impresses me at all. It's another slant on a well-worn idea that I am sure many games players are growing rather tired of.

A lot of effort probably went into producing the complex graphics display in Laser Reflex but the results are disappointing and at the end of the day it's just another shoot-em-up. Certainly not one for my collection.

P.R.

Ratings Table:

SOUNDS	35%
GRAPHICS	65%
DOCUMENTATION	80%
VALUE FOR MONEY	55%
OVERALL	50%

Title	**Ledgeman**
Publisher	**Software Projects**
Machine	**Model B**
Price	**£7.95**

After Ledgeman arrives home from the village auction with his bargain of the day, a Victorian bureau, he decides to dust away the cobwebs and put all his important papers and documents into the top drawer.

On opening the second drawer, he is astonished to find a map. The map gives directions to a hidden cave where precious stones can be gathered in abundance. However, it also warns you of the strange and perilous guardians of the cave, sentinent barrels, meteor storms and a host of wandering beasts.

With a preamble such as this, it's almost an anti-climax to find that Legdeman is actually the familiar platform and ladders type game. However, the graphics and the general presentation are of high standard. The various characters are well defined and the movement is smooth and flicker free.

Each screen is carefully designed so that you have to collect the jewels in the right order and timing is critical so nimble fingers and quick thinking are necessary for this game.

I did find that some of the screens were a little difficult but that doesn't detract too much from the fact that this is a very enjoyable Manic Miner derivative. It's perhaps a trifle too expensive though.

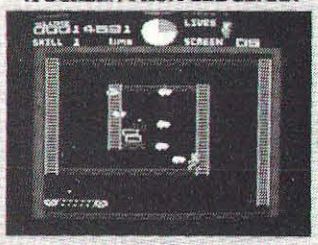
S.S.

Ratings Table:

SOUNDS	45%
GRAPHICS	40%
DOCUMENTATION	60%
VALUE FOR MONEY	50%
OVERALL	50%



A SCREEN FROM LEDGEMAN



OTHER GAMES IN OUR RANGE



Title	**Islandia**
Publisher	**Red Shift**
Machine	**Model B/Electron**
Price	**£9.95**

Islandia is an almost excellent (if somewhat overpriced) game, unfortunately marred by some flaws in the program which I hope the company will swiftly correct.

The program achieves what is almost impossible on the BBC micro due to its memory limitations — a decent strategy game which utilises a high resolution (Mode 1) graphical display.

After loading, one is given the option of colour or monochrome display and then a random set of islands is generated on the screen (you can request a new screen if you don't like it).

The game is played by between two and four players who each control a shipping company. Each turn consists of an economic phase and two movement and combat phases. One may purchase one of four types of ship — steamships, battleships, explorer and troop ships — and a number of armies. The idea is to conquer islands by transporting armies to them. Explorers discover the wealth of the island while the other warships can attack those of other companies or defend one's own territory.

In the movement and combat phase players move each of

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their ships in turn by appropriate key presses. Extra interest is added by the fact that ships other than steamships cannot sail directly against the wind.

The strategic complexity of the game is genuinely demanding, indeed better than some games I have seen that do not concede 20K to the graphics screen. Documentation is excellent — a detailed and properly printed booklet. So what are the problems?

The first two are probably unavoidable: the ships are displayed as single user defined characters, no problem on my high-res colour monitor, but on a TV set it's hard to tell one type from another. The save game facility is extremely slow since the 20K screen must be *SAVED and reloaded.

However, on reloading, the program asks "How many turns?", which is one of the original game options that should have been saved. Worse, on one occasion a reloaded game crashed with a "no such variable" error.

This is not the only bug I have found: sometimes a troopship is not allowed to move away from a port and occasionally random debris is left on screen. In one game this was deposited just outside one player's home port, blocking access for his ships and ruining the game. The input handling is also unfriendly: for example, an accidental Return press by one player to a final question can skip the first option for the next player.

Despite these problems the game is currently in strong demand for use by my family and has a rare originality to it. However, I do think that releasing software with the sort of bugs I have described is unforgiveable since they are readily discovered in a few hours of play. **J.E.**

Ratings Table:

SOUNDS	60%
GRAPHICS	80%
DOCUMENTATION	90%
VALUE FOR MONEY	65%
OVERALL	75%

Title **Music Tutor**
Publisher **Garland Computing**
Machine **Model B**
Price **£9.96**

This program allows the display of musical notation on the screen for any tune that is entered into the computer. The tune can then be played back at any tempo you wish with a small dot pointing to each note as it is played.

A tune can consist of up to 75 notes including all notes from semi-quavers to semi-breves, sharps, dotted notes and all rests.

The music can be input in one of two ways. Either as musical notation, entering each note one by one with its pitch and duration or by using the computer as a musical keyboard.

Once in memory the tune can be edited if desired and insertions and deletions made at any point. Single step playback can also be used to display the full Basic sound statements for each note, enabling the tune to be copied out for use within a Basic program of your own.

Use of the program is quite easy with the options being selected from a main menu which can be jumped back to any time. The display used for the music is a white background with the notes and stave shown in black.

I let my twelve-year-old niece use this program as she is at present taking her first steps in learning music. Her reaction to it was most favourable and she had little trouble understanding how to use it.

Music Tutor is certainly an interesting and useful program but on its own will not teach you the rudiments of music. In fact it assumes you already have a certain amount of knowledge of music, because without that it is impossible to enter any musical notation.

In effect all it really does is enable a student of music to enter simple tunes via the keyboard or by notation and then play them back. Watching the note being printed at the correct position on the stave whilst it is being played is obviously very helpful in learning to recognise small differences in pitch which some people find very difficult at first.

In conclusion, I would say that used in conjunction with other music studies Music Tutor is certainly of value, but on its own will do very little. **P.R.**

Ratings Table:

SOUNDS	45%
GRAPHICS	40%
DOCUMENTATION	70%
VALUE FOR MONEY	50%
OVERALL	45%

Title **Felix Meets The Evil Weevils**
Publisher **Micro Power**
Machine **Model B**
Price **£6.95**

This was my first encounter with Felix and the snakes-and-ladders type of arcade game, and I found it very enjoyable. The aim of the game is to score as many points as possible, and there are a number of way to do it.

The scene is a factory where a number of conveyor belts, at different levels on the screen, are connected by tunnels. Felix has to run round the factory collecting letters, oxygen cylinders, levers and cans of insecticide. The latter item is essential for survival, as also running around the factory are weevils who can only be killed by a spray of insecticide. This has to be administered directly to the weevil, so not only is close combat called for but you also have to make sure that Felix is pointing the right way.

To make things a little more difficult the touch of a weevil is fatal, as is a blow from one of the ball-bearings which are dropped onto the top-most belt, and proceed along the belts and down the tunnels until they reach the bottom of the screen.

Whilst Felix is vulnerable to the ball-bearings, the weevils are not. One protection against the ball-bearings apart from avoiding them is, after the "belt reverse lever" has been collected, to reverse the direction of the belts, hopefully moving the ball-bearings away from Felix.

Points are scored for collecting the items and letters, with a bonus for collecting all the five

letters which spell BONUS. Killing a weevil earns 500 points, which is doubled to 1000 if you get it after it has mutated into a super-weevil. This moves a lot faster and can quite easily catch you unawares.

The graphics are very good with smooth movement in all directions. Control is only through the keyboard as there are too many options to implement on a joystick. In fact I found that there were too many keys to be used. Apart from the four direction keys, Z, X, *, ?, RETURN sprays the insecticide, SHIFT reverses the belts and SHIFT LOCK is a panic button. This can be used once per life to give Felix temporary immunity from both weevils and ball-bearings. The problem is that I kept on forgetting to use it.

Having successfully disposed of the pursuing weevils Felix progresses to a second screen. Here the principles are the same, but the belt/tunnel pattern is different and there are three pursuing weevils where there are only two on the first screen.

If there are any more screens I failed to get on to them, but I am improving and if only I can remember the panic button I might yet find out.

D.A.

Ratings Table:

SOUNDS	65%
GRAPHICS	85%
DOCUMENTATION	60%
VALUE FOR MONEY	80%
OVERALL	75%

Title **Star Striker**
Publisher **Superior Software**
Machine **Model B**
Price **£7.95**

If you like galaxian type games then this one from Superior Software will provide you with plenty of different screens of aliens to exterminate. Strange looking aliens they are too I might add.

These weird looking beasties wander round the screen in what can almost be described as a dancing motion. In fact I found it rather hypnotic after a while and was glad when I had shot down a few as this makes them mutate and behave in a different way.

Further screens feature many other unusual creatures including what appear to be some rather large animated snowballs that whizz across the screen doing their best to flatten you.

After a few screens have been wiped out you are given the task of docking two rockets together which certainly helps to break the tedium. A time bonus is awarded should you manage to achieve this difficult task successfully.

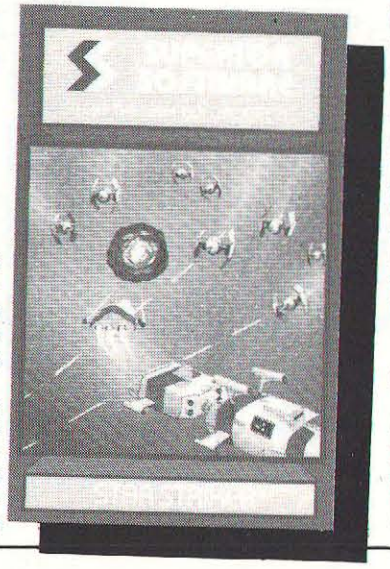
That really is all there is to this game. Screen after screen of aliens with the occasional lunar lander type exercise thrown in for good measure.

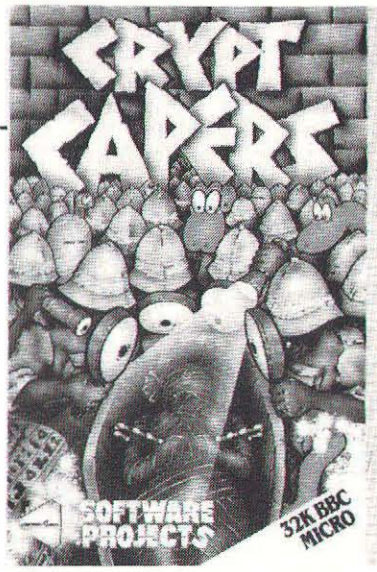
There is nothing startling about the quality of the displays in Star Striker. The screens are rather bare-looking actually with graphics that are slightly different from other games of this type, but this doesn't make this game any more interesting.

I can't summon up much enthusiasm for this alien thrash at all. It's just another variation of many other games I have seen before and which in most cases are far better than this one. Not recommended. **P.R.**

Ratings Table:

SOUNDS	50%
GRAPHICS	55%
DOCUMENTATION	70%
VALUE FOR MONEY	50%
OVERALL	55%







Title **Crypt Capers**
Publisher **Software Projects**
Machine **Model B**
Price **£7.95**

This is a top class arcade game. There is a series of screens, each of which has a maze of tunnels to be negotiated. There are keys to be collected in order to move through an exit to the next screen and optional treasures for points.

The hazards include fireballs and snakes which must be either dodged or shot, though shooting loses you bonus points. On higher screens there are indestructable moving rocks to avoid. The graphics are excellent and the use of sound above average for an arcade game.

The game employs a protection method I have not seen before. A program protection card is included which has four coloured bars in each of 360 cells. On loading, the program asks for the code in a given cell, eg G7. One must then enter the initial letters of the colours. I presume colour is used to prevent effective photocopying of the card. It is nice to see a method which does not prevent the owner from backing up or transferring his program to disc.

J.E.

Ratings Table:

SOUNDS	80%
GRAPHICS	85%
DOCUMENTATION	75%
VALUE FOR MONEY	80%
OVERALL	85%

Title **Tarzan**
Publisher **Alligata**
Machine **Model B**
Price **£7.95**

In this rather zany game from Alligata you are confronted with the task of guiding Tarzan through the terrors of the jungle to rescue his sweetheart Jane. The scenery is not quite as I remember it from the films however. Lifts in the jungle?

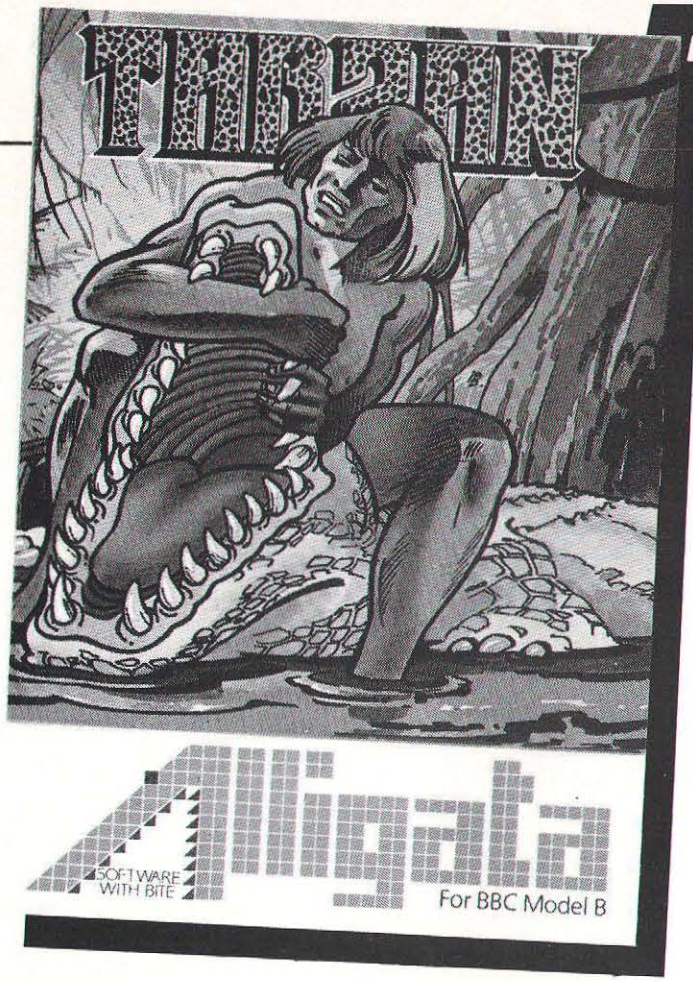
There are four screens to negotiate with a whole host of weird and wonderful hazards to impede the progress of our loin-clothed hero. Apart from the more usual inhabitants of the jungle such as snakes, gorillas, baboons and crocodiles, there are flying saucers, gnashing teeth — and a very large eyeball! Some of the objects featured on some screens of the game really defy description.

On each screen Tarzan must find his way to the signpost with the arrow on it before he progresses to the next and finally on the fourth gets to his loved one, Jane. There are rivers to cross, trees to climb and ravines to jump, apart from all the meanies waiting to ambush him. Lifts provide the means of moving from one point to another, but these are hazards themselves needing sharp reactions to avoid being crushed.

A demo mode is provided in the game to enable a glimpse of the screens to come. When I say a glimpse, I mean a glimpse as they cycle through at a rapid rate

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of knots.

Scoring in the game is worked out on the time taken to complete the current screen. One feature I like is that you don't lose a life if you fall from any point to the bottom of the screen, unless of course you happen to land on a hazard or meanie of some kind.

Graphics in Tarzan are a little bizarre to say the least, but nevertheless really excellent and very reminiscent of Blagger in some ways. The amount of flicker-free animation on all screens is quite remarkable. Sound is good too, right from the tune played whilst loading to the effects in the game itself. Never annoying but adding to the game effectively without going over the top.

The only thing I found to criticise in Tarzan was the lack of a high score table for those who need one. Apart from that, this is a real gem of a game which has that element of addictiveness and fun that makes you go back to it again and again. A definite must for any Beeb game fanatic.

P.R.

Ratings Table:

SOUNDS	75%
GRAPHICS	85%
DOCUMENTATION	70%
VALUE FOR MONEY	80%
OVERALL	85%

Title	**Plutonium Plunder**
Publisher	**Micro Power**
Machine	**Model B**
Price	**£6.95**

Scenarios for games can sometimes be a little bit over the top but, "Clear a path through the vault and shove the radioactive cannisters behind the safety barrier before all hell breaks loose and the Megapods and oscillating Nuclids appear"?

This is in fact a block pushing game where three blocks — the radioactive cannisters — have to be pushed through a hole in a frame — the safety barrier. Trying to prevent you from doing this are other passive blocks which have to be pushed out of the way, and four pursuing creatures whose touch is lethal. These can be killed by pushing either type of block into them.

When the four pursuers have been disposed of there is a time limit to get rid of the radioactive cannisters before the game area starts filling up with passive blocks. Once you are blocked in the screen clears leaving you and any radioactive cannisters not yet rendered harmless. Your aim is still to push the cannisters through the hole in the frame, but now you are pursued by the Megapods who come after you, and the Nuclids who spend their time going from side to side. You can shoot at your attacker but only by running at them, in order to get your gun pointing in the right direction.

I haven't yet managed to remove the three cannisters on the first screen, so have yet to discover what follows. The problem is that the game is rather difficult. Random placing of the cannisters and blocks means that sometimes they are almost impossible to collect until the screen clears and phase two starts. Then the pursuers move so quickly that survival is difficult, let alone moving the cannisters around. Perhaps I'm just not cut out for a job with the Atomic Energy Authority.

As a game, despite the scenario, it is good. The graphics are excellent with smooth movement, and are well supported by a range of sound effects. Keys are user-definable, or joysticks may be used. Colour is well used and particularly effective when you run into the electrified wall/frame.

This wall must be made of a rather unique material because as well as conducting electricity it also appears to be elastic. Any block pushed into it rebounds with usually fatal results.

D.A.

Ratings Table:

SOUNDS	65%
GRAPHICS	80%
DOCUMENTATION	60%
VALUE FOR MONEY	80%
OVERALL	70%

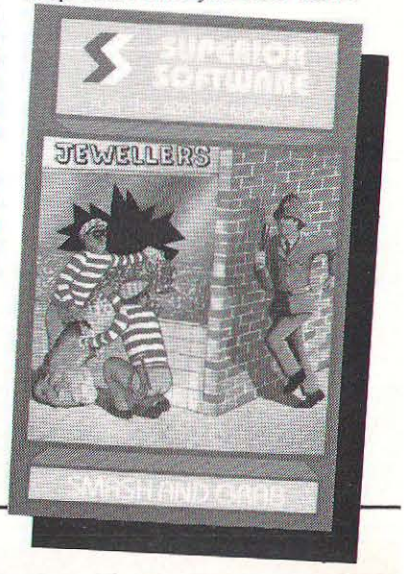
Title	**Smash and Grab**
Publisher	**Superior Software**
Machine	**Model B**
Price	**£7.95**

Ever fancied trading your nine-to-five existence for the excitement of a life of crime, robbing banks and living life as a wanted man? When you've met the policeman in this game from Superior Software you may well decide it's not such a good idea after all.

In Smash and Grab you are the villian who has just booted a traffic cone through the window of the local bank. Out through the gaping hole drift the sacks of loot and you must grab them before they disappear into the river below. Sounds easy enough doesn't it?

Unfortunately, your misdeed has caught the attention of a nearby policeman. Now this guy is not your friendly neighbourhood bobby, he combines the agility of a monkey with an almost psychopathic desire to bring about your early demise. In short, he's an absolute lunatic!

When you are on the level above him he reaches up with his truncheon and gives you a swift wack around the shins causing you to topple off. If he catches you below him, he drops down onto his stomach and leans over the edge to give you a nasty battering round the head. By way of a change, occasionally he will drop down onto you from above



and with the aid of his size tens deposit you in the river.

To add to your troubles there are frequent appearances of three flying traffic cones that you must dodge rather smartly or else attempt to kick out of the way to gain extra points.

The only help available to you comes from the four police boxes located at various points. When the light flashes on the top of one of them you must get to the box quickly and give it a sharp kick. Having done so you can now dispose of PC Plod when you next encounter him. At the same time the bags of money stop drifting which makes it easier for you to collect them.

This state of affairs only lasts for a short while and soon the demon Plod climbs from the river where you sent him and the fun begins again.

Points are scored for kicking the flying cones, collecting the money bags and knocking Plod into the river. You must collect eight of the money bags before progressing to the next screen.

Smash and Grab breaks no new ground as far as the graphics are concerned with nothing that you probably haven't seen before in other ladders and girders games.

Sound is quite good but there is nothing outstanding here either. What does set this game apart from others though is the humourous aspect of it. It's a lot of laughs. Be warned however, the game is not easy and requires a lot of effort to even get to the second screen. **P.R.**

Ratings Table:

SOUNDS	50%
GRAPHICS	70%
DOCUMENTATION	70%
VALUE FOR MONEY	60%
OVERALL	70%

Title	**Ewgeebez**
Publisher	**Software Projects**
Machine	**Model B**
Price	**£7.95**

Zelob the Melkon has been marooned on the space station Ewgeebez. To escape he must collect twelve power crystals to activate the main teleport, which he has to find in a mass of corridors.

Easy enough task you may think to yourself, but you haven't taken into account the alien creature which regularly teleports in from neighbouring foreign planets and of course the space stations own defense mechanisms — the patrolling robots armed with deadly laser beams.

And so goes the description of the inlay card. Roughly translated, it means that you control a little creature in a maze and must collect twelve crystals avoiding the monsters mentioned above.

Trivial you may think, but the maze is big and the graphics are good. Mode 1 is used so individual characters are incredibly detailed. The various creatures are superbly animated and they all behave in a different way. It will take you a long time to map out the maze and to finish the quest.

It may not be the most original and mind shatteringly complex game ever devised for a home computer but it is very good fun. **S.S.**

Ratings Table:

SOUNDS	50%
GRAPHICS	80%
DOCUMENTATION	30%
VALUE FOR MONEY	50%
OVERALL	53%

Title	**Aces High**
Publisher	**Oasis Software**
Machine	**BBC Model B and Electron**
Price	**£14.95**



Aces High is a set of four card games, comprising of Pontoon, Blackjack, Draw Poker and Stud Poker. It comes on two cassettes supplied in a rather nice video-cassette style case, along with a 20 page manual. All the games will run either on a BBC or an Electron computer.

The manual supplied is extremely good, giving a detailed description of the rules of each game for those not already familiar with them. At the back of the manual is a section describing the origin and history of each game which is very informative.

The games themselves however don't live up to the professional presentation of the manual. They are pretty standard stuff as computer card games go with little flair or imagination used in the screen layout and graphics. Some variable height text drawing routines would certainly have done much for this game, instead of the boring and cramped look of the standard mode 1 characters.

Mercifully, picture cards do have pictures unlike some programs I have seen in the past. Each card is drawn on top of the other with a slight offset allowing the values of each card in the hand to be read. The usual betting and banking routines are used in all the games. There is a fixed maximum betting level and the computer and player take turns in being banker. An option is provided for playing against the computer or with up to five players participating.

Although you may consider sound has no place in a computer simulation of this kind, I would have expected a little more than the standard and rather nauseating BBC bleep for the prompts. I have seen card games on other computers where even the flick of the cards is reproduced as they are dealt and drawn. In Aces High you get no such subtle use of sound.

Overall I found this set really disappointing. There is a great deal that could have been done to improve the graphics and make the games that much more interesting and professional in their presentation. As they stand, they don't even come up to the standard of some magazine listings I have seen and don't represent very good value for money at the price being asked either. Definitely not one to storm the software charts. **P.R.**

Ratings Table:

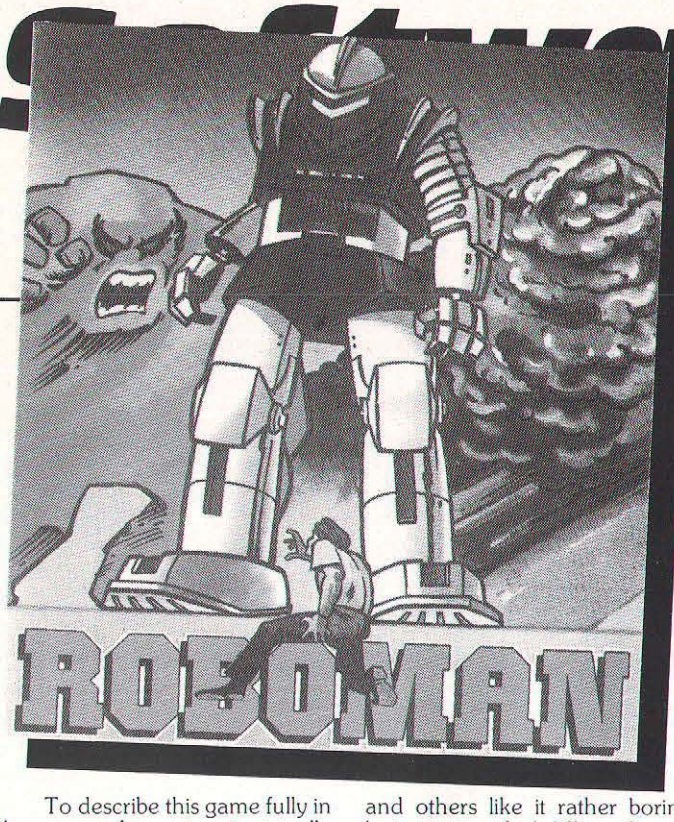
GRAPHICS	40%
DOCUMENTATION	90%
VALUE FOR MONEY	30%
OVERALL	35%

Title	**Time Lords**
Publisher	**Red Shift**
Machine	**Model B**
Price	**£9.95**

Time Lords is a strategy game for one to five players where each player takes the role of a time lord. The task is to outmanoeuvre the other time lords and ensure the race you represent becomes the dominant race in the universe.

CONTINUED OVER

Software Reviews



To describe this game fully in the space of a review is virtually impossible as it is so involved and complex. Basically, you have to wander around the time zones in the universe laying traps for other time lords and engaging in battles to achieve overall supremacy. The best way to give an overall description is by saying it is akin to playing chess without knowing where your opponent's pieces are situated.

Time Lords comes with a twelve page instruction manual that I found real brain scrambling stuff and had me searching for the headache pills after twenty minutes study of it.

When played as a multi-player game Time Lords requires all other players to leave the room during one player's turn at the computer. I found this a bit of a drag to say the least and it's not something most of my friends took to either.

Graphics in the game are in mode 7 and consist of a scanner grid showing the position of the various planets and time zones in the universe. The only animation in the game is the arrival of the tardis to the accompaniment of those well known grinding and screeching noises.

I would venture to say that strategy games are very much a minority interest judging by the reaction of the many computer game-playing friends I have. You either love 'em or you hate 'em.

Personally I find this game and others like it rather boring, but you may feel differently.

P.R.

Ratings Table:

SOUNDS	45%
GRAPHICS	40%
DOCUMENTATION	60%
VALUE FOR MONEY	50%
OVERALL	50%

Title	**Roboman**
Publisher	**Alligata**
Machine	**Model B**
Price	**£7.95**

Due to a genetic engineering error, you are possessed with super human powers in a world where robots are taking over the human race. As such, you must fight against overwhelming odds to save the last family on Earth.

Sounds familiar? Yes, that's because it's straight out of Robotron, the super fast shoot-'em-up by William Electronics that proved so popular in the arcades a couple of years back. Well, Roboman is a very good copy of that game.

You control a little character in a room full of robots who incessantly follow you about. The first few waves are easy but as you progress, soon the number of robots increase and they start to move in faster. Also, indestructible hulks, grunt robots and evil mutant brains appear on the scene to make things even more hectic.

The graphics are very good. The carefully designed multi-coloured characters are animated very well. In contrast, the sound is rather a disappointment. Surely it could have been a lot more exciting than a few blips and squeals from time to time? Also, I was quite surprised to find that the almost obligatory hall of fame feature had been left out but in any case, fast and furious action and the overwhelming odds should suit all you dedicated shoot-'em-up fans out there.

S.S.

Ratings Table:

SOUNDS	30%
GRAPHICS	85%
DOCUMENTATION	50%
VALUE FOR MONEY	70%
OVERALL	60%

Title	**Microgo 1**
Publisher	**Edge Computers**
Machine	**Model B/ Electron**
Price	**£9.95**

At last! The world's first commercially available Go program, Edge Computers tell us, so this could be a breakthrough unmatched since the first computerising of chess. As Go is much more difficult to program than chess, it is not surprising that Microgo pioneers the field on a quartersize board.

The demo game (optional) is excellent, covering not only the rules but some of their trickier applications, and explanations are lucid. The graphics are lively, Microgo lobs his stone up in a graceful arc to land on the board with a sound admirably like the click of stone on wood, and a spreading ripple draws one's attention to the point.

A groan arises if you try to confirm a move on a point already occupied, and a curious warble accompanies the removal of prisoners. Sound is of course optional, but a beep for "atari" (the Japanese for "check") should have been incorporated, as the printed warning might be missed if you are poring over the board.

Messages are friendly in the main, but it is not pleasant to be told "Faster! Faster!" in a game many people consider more subtle than chess, and if left long, Microgo gets bored and wanders off to play the demo game.

Microgo certainly understands basic strategies such as cutting and connecting, and is so fiendish at killing groups a beginner might consider safe, that this takes it up to the level of 15 kyu (six months to a year of playing experience for most people) claimed for it by the publishers. We tried the program out against a three kyu player, a 10 kyu, and a 20 kyu. The three kyu predictably beat it even against the maximum five stone handicap allowed. The 20 kyu lost decisively from evens. Trick-play can pay off, however, and the wily 10 kyu lost by only two points against the maximum handicap.

Opening play is sometimes erratic, sidepoints being taken whereas grabbing the corners on such a small board is vital. Microgo once put itself into atari in order to give atari.

The real defect, though, is a tendency to pass too early, when the program presumably reckons it has a comfortable win. An advanced player — or one who is just plain cunning! — can, for example, risk building a "dead" line around the board, then take advantage of a couple of supercilious passes to home in and snuff out some major group. However, be warned! Microgo sometimes wakes up to the danger, kills your line, and wins decisively.

To be fair though, the program is obviously directed towards beginners with little or no experience. They will find it an excellent method of learning to play Go, and even pick up some of the subtleties of the game, before venturing out to join a Go club.

B.T.

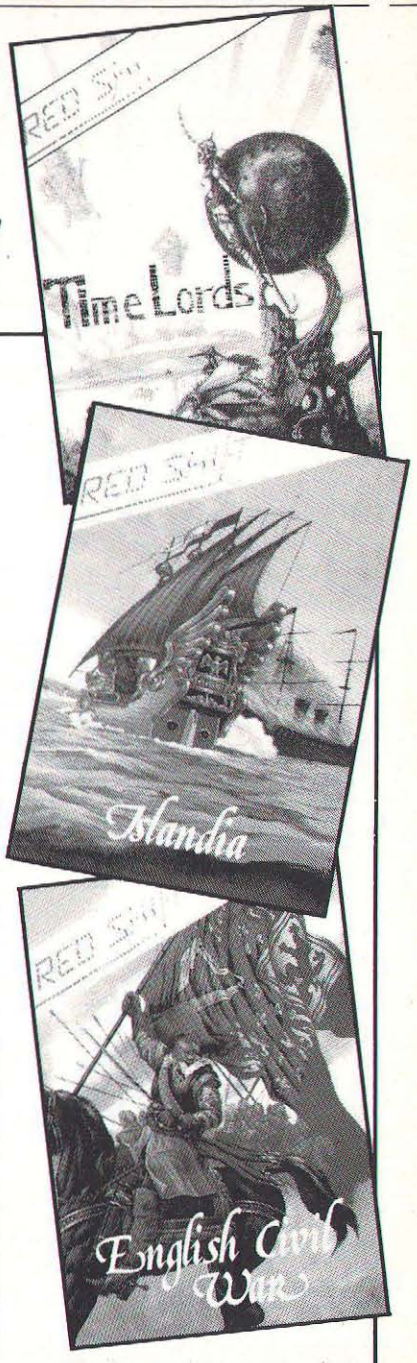
Ratings Table:

SOUNDS	90%
GRAPHICS	85%
DOCUMENTATION	100%
VALUE FOR MONEY	90%
OVERALL	90%

Red Shift Into Gear

Ione Holmes

Three exciting new strategy games have been launched by a small software company hoping to make its name big with thinking games for the computer.



A tatty office over a shop in a residential street in Stoke Newington, east London, seems an odd place to find an up-and-coming software company, but the ideas and programs coming out of the converted flat from Red Shift are professional, well-presented and interesting.

Perhaps it was lucky that when I went to see them their young manager, Charles Ablett, hadn't spent the previous night there, as he often does, because they'd just been burgled. Apparently a 6'4" muscle-man had managed to extract one computer and three televisions through the second floor window (first cutting the bars that protected it) and whisked them down the ladder and away. Fortunately he aroused the attention of a next door neighbour and was caught later by the police.

Red Shift have been in business for almost two years but Ablett, also a director, took over last May. The company was originally formed by a couple of programmers and a financial backer in order to produce what they considered "thinking games for the computer". Although they had the ideas, they lacked commercial experience and became bogged down in paper work. Disillusioned and losing money they gave up and Ablett, who worked in the shop below, saw his chance.

With the help of Chris Shafte, a professional salesman, and two administrative staff, he took a month to completely reorganise the firm, sort out the debts, arrange finance and commission new programs. He has learned from the previous mistakes and realises the importance of good management, distribution and advertising.

Now that the company have launched three new titles the stock/living room shelves from where their products are despatched can't cope, so they hope to expand and eventually employ a "YOP" or two.

Red Shift only sell "strategy" games which they see as a continually expanding market. They need to predict the games which will be in vogue in the months ahead and must follow market demands — both for kinds of games and relating to which computers.

They aim to reach what Ablett calls the "adult, intelligent market", obviously filled with BBC owners as well as users of the Electron, Commodore and Spectrum. He feels that part of the attraction of their strategy software is that, rather than staring glassy-eyed at a screen, the players can think and talk while using the computer to take care of the routine tasks. The players don't compete against the computer but each other, making a much more sociable game.

When Ablett took over, the company had two games on the market, the main one being Apocalypse. It has been fairly successful considering the poor marketing, although sales figures weren't helped by W. H. Smith refusing to stock it because of its references to nuclear war. They wouldn't even be persuaded by an endorsement from CND!

Apocalypse and the other remaining original title, Nebula, have been brought into line with the house style chosen for the new programs. Each tape is presented in a distinctively covered box containing the instruction booklet. Ablett is convinced that "good artwork sells games" so the illustrations are very important and certainly stand out.

The new software — Timelords, English Civil War (a subject close to Red Shift's heart since three of the members belong to the "Sealed Knot Society") and Islandia — have had their presentation and content thought out carefully. All are very visual and although easy to learn need skill to play. Further titles are planned, linked with the BBC.

The new titles were designed by freelance programmers although Charles, a programmer himself, contributed his ideas. When each was completed it was extensively tested for bugs and then a master made. Setting up the new software was expensive. Cover artwork had to be commissioned and plates made, complete with costly typesetting. Each cassette had an initial run of approximately 1000 duplicates depending on the computer for which it was intended and these had to be packaged in their covered boxes with instructions and rule book.

Apocalypse, English Civil War and Timelords are going to be available on disc and there is a possibility that the company will become entirely disc based because of the greater computing capacity available. On the other hand distributors and retailers prefer cassettes because they are easier and more attractive to display, so the discs will be available in specialist shops initially to see if demand is sufficient.

Like many software companies, Red Shift are very concerned about piracy of their programs. They are doing all they can to minimise it — mainly by making sure their titles are readily available and well produced with booklets etc to make the whole package desirable, rather than just the cassette — but even so, if copying gets much worse they are considering dropping BBC titles except for the international market.

For the future, Red Shift intend to increase their range of strategy games, to become more involved with disc production and to develop their titles for use on a greater variety of computers. But their greatest ambition is to succeed overseas, where microcomputer use is growing rapidly all the time. If their initial enthusiasm is anything to go by, they should do very well.

Making the most of Assembler

BBC and Electron Assembler power is easily available to the programmer. Make the most of it.

Coming new to a microcomputer and expecting to be able to shoot multicoloured sprites all over the screen or knock up a user friendly database within the month is possibly what you might have expected from your micro if you believed some of the advertising sprayed about last Christmas.

Programming is not like that unfortunately. It is rather more of a slog, especially when it comes to the mysterious realms of machine code. Somewhere in the midst of the BBC BASIC chip is an assembler. Unlike some other machines, you don't have to buy in software to assemble instructions into machine code.

OPEN SESAME

Getting into the assembler couldn't be easier. You can even do it from BASIC. All you have to do is start the line with the [character. Your micro now expects to find assembly language instructions (the 6502 has 56) for it to work on and change into machine code. You finish off the assembly instructions with a]. Easy.

Of course the resultant machine code has to go somewhere in memory, found again by the system and possibly saved to tape or disc. There are various ways to go about this.

The examples at the end of this article should make it clear what is happening to your code and why. Type them in and see. The location of your assembled code can be determined in two ways. You can use P% to tell the assembler where to put it. Alternatively you can use DIM to reserve a certain amount of space for your code and leave it up to the computer to decide where it should go.

The latter of these two options is the safest to start with but the former allows you, the programmer, to have complete control over where in memory your code is to reside from the start.

If you wish to move your machine code about, a simple method is to *SAVE it and then *LOAD it back in where you want it. Let's suppose you wanted the code generated by Program 2 at &2000 onwards. *SAVE it with the following trailing instructions: memory location &304E, end of code &3054, run code from &304E. *SAVE &304E 3054 304E. The last instruction is optional. If it is not included then the computer will assume the start address to be the run address.

You can now *LOAD filename &2000. The new location has to be specified to override the former address (&304E) which was saved along with the code. You can now use *SAVE &2000 &2006 &2000 to save the code for automatic loading at &2000 with *LOAD or (the equivalent of CHAIN in BASIC) running the code with *RUN.

EXAMPLES

The program examples consist of two parts each. The first is to be typed in. The second is what you will see on the screen at assembly time. In the listings line numbers are used as usual. Anything written after the \ character (the key is left of the left cursor key) is ignored by the assembler. These comments are the equivalent of REM statements.

The screen at assembly time displays, reading from left to right through the columns, the memory location (in hexadecimal), the hexadecimal codes for the assembly instructions (eg A9 = LDA) and the data upon which they are to work. Finally, on the right, there is the listing which you have just typed in.

The examples demonstrate some very simple but interesting features of the BBC and Electron assembler. Note the use of an operating system routine called OSASCI, a routine which resides in the O.S. ROM at location & (hexadecimal) FFE3. This routine takes the value currently in the accumulator and prints it to the screen at the current cursor position. It doesn't provide a line feed.

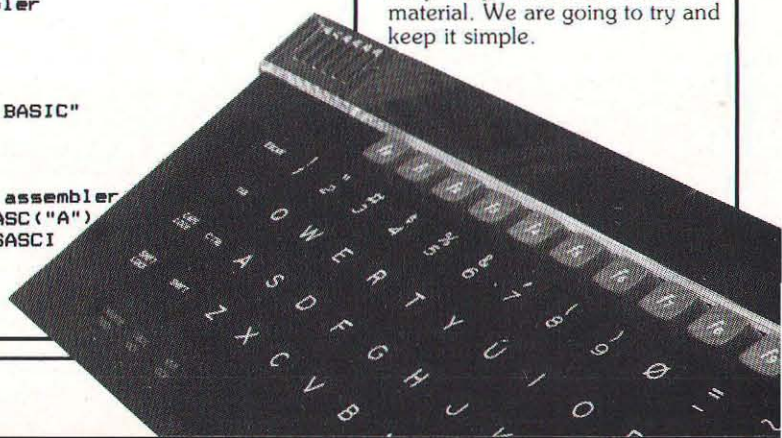
The JSR Jumps to Subroutine OSASCI. An RTS within the routine returns to our next assembly instruction, which turns out to be another ReTurn from Subroutine. I always start humming when I use this instruction because my own personal mnemonic for RTS is Return To Sender. I'm not sure whether Elvis would have approved. The nice thing about RTS is that it doesn't come back with an "Address Unknown"! Our RTS instruction returns us finally to BASIC.

Note also the use of a BASIC command within the assembler part of the examples. ASC returns the ASCII (American Standard Code for Information Interchange) value for "A" (65). This is Loaded into the Accumulator. Using BASIC features to simplify affairs within the assembler leaves you with no overheads at the machine code stage so why not? It beats looking up a table of ASCII codes every time.

I hope that this low level introduction to assembler will encourage those who fancy a try at it. Future articles in the series will explain and demonstrate further how you can incorporate assembler into your BASIC programs as well as writing pure machine code software. Our sister series Machine Code Made Easy will provide more advanced material. We are going to try and keep it simple.

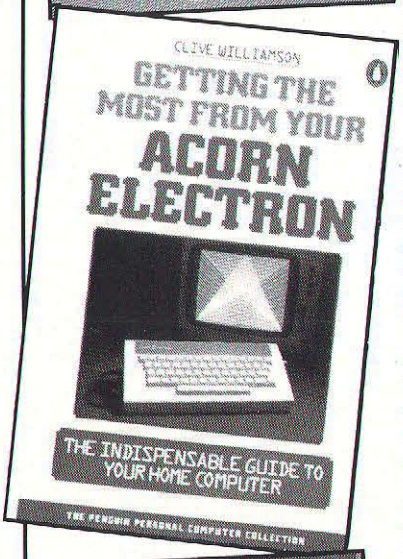
```
   10MODE 6
   20 OSASCI=&FFE3
   30start%=&2000
   40P%=start%
   50 [ \into assembler
   60 LDA #ASC("A")
   70 JSR OSASCI
   80RTS
   90]
  100PRINT "BACK IN BASIC"
  110CALL&2000
>
>
>RUN
2000             \into assembler
2000 A9 41       LDA #ASC("A")
2002 20 E3 FF    JSR OSASCI
2005 60          RTS
BACK IN BASIC
```

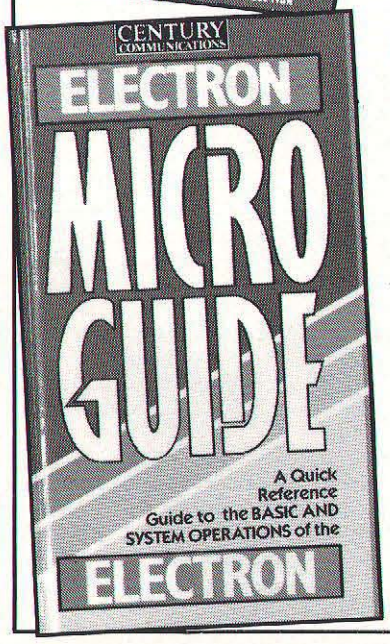
```
   10MODE 6
   20 OSASCI=&FFE3
   30DIM code &10
   40 [ \into assembler
   50 LDA #ASC("A")
   60 JSR OSASCI
   70RTS
   80]
   90PRINT "BACK IN BASIC"
>
>
>RUN
304E             \into assembler
304E A9 41       LDA #ASC("A")
3050 20 E3 FF    JSR OSASCI
3053 60          RTS
BACK IN BASIC
```



Electron Books







Electron owners need never be without a good read.

Although the Electron owner might complain that he or she doesn't benefit from the stream of quality software that the BBC owner gets, no such complaint can be levelled about books.

If you are new to the world of Acorn jargon then Eric Deeson's Easy Programming for the Electron will guide you gently into programming, as long as you are willing to stick at it and type in numerous examples. It will also take you on to dabble in a bit of more advanced stuff.

There's the usual homage to sound and graphics but also lucid explanation and advice on how to program in a planned and structured manner. The programs themselves are not ambitious and lack originality but are solid examples for the beginner.

If you wish to move on a stage, Clive Williamson has written an excellent guide to programming. Penguin have produced a very attractive book with some colour illustrations, explanatory diagrams and appendices. The programming style is not really suitable for the first timer but anyone who has gone through the manual and Start Programming will be able to tackle most of this book.

Getting The Most also has some handy sections on the Plus One, future expansions (intelligent guessing!) and advice on the uses to which you can put your machine.

John Scriven with The Working Electron also has some ideas about how you should put your computer to work. Domestic database, graphics and character designers, business accounts, diary, graphs, a linear projections program, and the educational "Typist" and "Synth" all are listed and described. The author also goes into programming methods and his own are designed to encourage the reader to have a go with meaningful variables and procedures in constant use.

Another handy book for potential programmers is the Penfolds' Introduction to Programming. This is not a comprehensive introduction but rather an extension to the manual. It's full of interesting examples of clever programming. You can't go wrong at the price and it also has a rare chapter on Electron interfacing.

If you want a quick reference guide other than the manual by your computer then why not try the Phoenix computer crib card. It's just the sort of thing Acorn should have included with the manual (Acornsoft's Logo and Pascal have similar cards). £1.99 strikes me as being a bit on the expensive side but if you need that forgotten parameter in a hurry...

Century's Micro Guide supplies similar information in a hard cover. This is an important advantage for something that is likely to get considerable use as the programmer fumbles for the right page.

Easy Programming for the Electron by Eric Deeson. Published by Shiva. Price: £5.95.

Getting the Most from Your Acorn Electron by Clive Williamson. Published by Penguin. Price: £6.95.

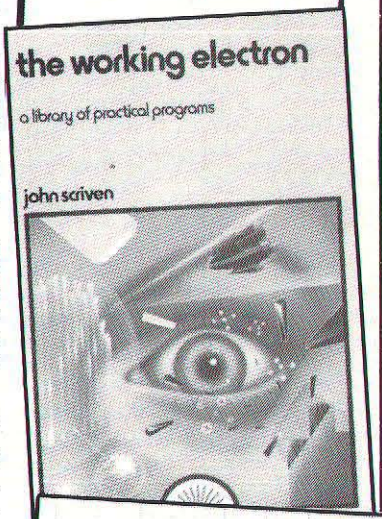
The Working Electron by John Scriven. Published by Sunshine. Price: £5.95.

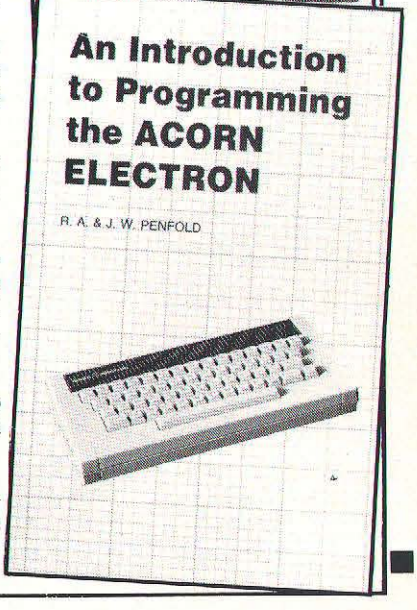
An Introduction to Programming the Acorn Electron by R. A. and J. W. Penfold. Published by Bernard Babani. Price: £1.95.

Phoenix Computer Crib Card. Published by Phoenix Publishing. Price: £1.99.

Electron Micro Guide by Professor Peter Morse and Brian Hancock. Published by Century. Price: £1.99.







Electric Software

Giuseppe de Benedictis

Software for your Electron.

Title Superpool
Publisher Software Invasion
Machine Acorn Electron
Price £7.95

Superpool is Software Invasion's version of the popular pub game.

There are two very important features in any version of this type of game. The first is that the screen display must be clear and umuddled. This program is excellent on colour and presentation, the balls being very easily distinguishable against a green background. The second essential feature is a true flicker-free representation of the movement of the balls, be it off cushions or after hitting other balls.

Unfortunately Superpool is not very close to real life. (Though I must say that the rarity with which I managed to pot balls is very realistic!) However, don't be discouraged by this shortcoming since none of the versions of any snooker/pool game have yet come up with a good pattern of movement.

The game itself is made up of three parts to each level of difficulty. The parts consist of firstly potting the six numbered balls in any order, then potting the numbered balls in the correct order and finally both hitting and potting the balls in the correct order. My name isn't Steve Davis and so I haven't managed to hit the second level. Any mistake is punished by the loss of one of your "lives", of which you have three. These aren't enough for someone with my lack of skill.

My main gripe with the game is that there is a time limit on each shot. This means hurrying what are already very difficult shots and I think is a bit over the top.

Never mind though, this is a thoroughly enjoyable game and well worth adding to your software library.

Ratings Table:

SOUNDS	80%
GRAPHICS	95%
DOCUMENTATION	70%
VALUE FOR MONEY	95%
OVERALL	90%

Title Rubble Trouble
Publisher Micro Power
Machine Acorn Electron
Price £6.95

Each time I open a computer magazine I find that the prolific software house Micro Power has released yet another game for the Electron. The latest offering from the stable of Killer Gorilla and Ghouls is Rubble Trouble.

The program bears a striking resemblance to Percy Penguin in the way it is played. As is the case in many of these types of game, the player is in control of a man who can go left, right, up and down as well as having the ability to push rocks. The scenario is a maze made up of rocks around which wander a number of strange animals that are up to no good. Apparently their staple diet is human flesh!

The aim is to obliterate the meanies that begin life by hatching out of eggs. These are killed by squashing them with rocks that have been pushed. However, beware! Should you push a rock and miss the monster then you'd better get out of the way quick, because the rock will rebound towards you (hence the title).

Once all the monsters on a screen have been killed a player then progresses to the next level where there are more to be found. The quicker you finish a screen the more bonus points are won.

At the first level, completion doubles the points earned, at the second four times, at the third six times, etc. The game is made more interesting by having different types of maze which vary between all rubble and monsters being visible to an invisible maze where you wander around blindly, trying to find your way around and still trying to survive.

This is a reasonably good game involving a fair amount of dexterity and strategy in order to succeed. Whilst the graphics and sound are to the usual very high standard that we've come to expect from Micro Power, they must soon look for some new ideas, because this is really a variation on a theme that has been well and truly flogged.

However, if you've not got a game of this type it is as good as any version on the market.

Ratings Table:

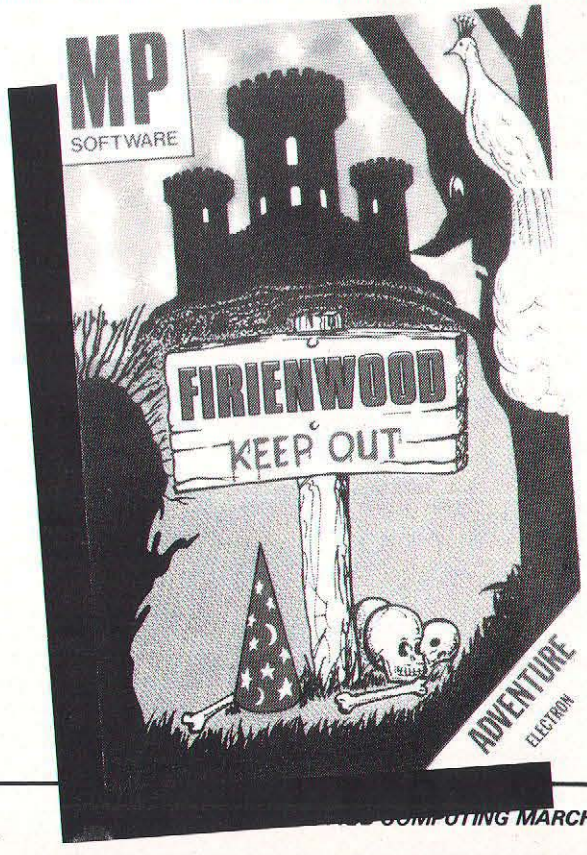
SOUNDS	80%
GRAPHICS	95%
DOCUMENTATION	85%
VALUE FOR MONEY	90%
OVERALL	80%

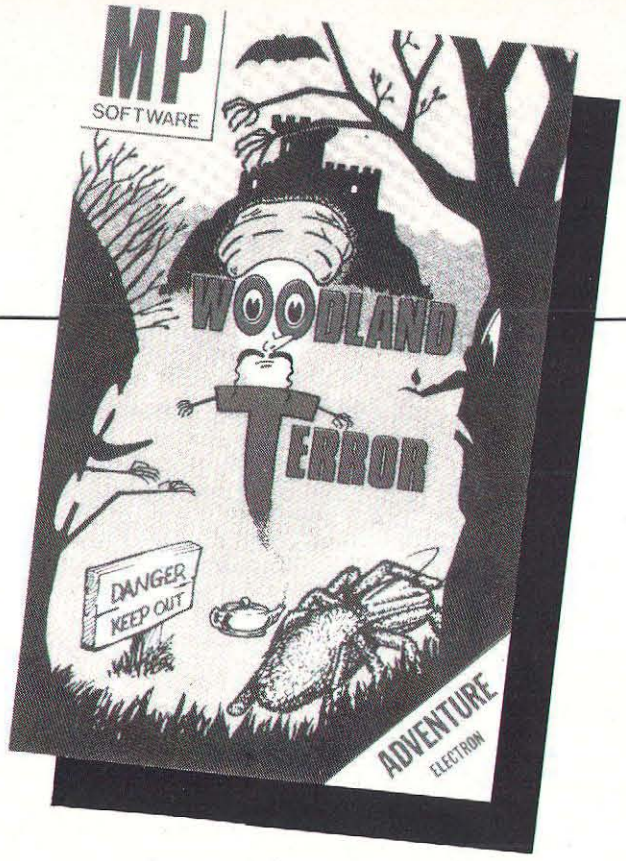
Title Firienwood
Publisher MP Software
Machine Acorn Electron
Price £7.48

The objective of this adventure from MP Software is to find and set free the Golden Bird of Paradise. The Bird has been captured by the evil wizard and imprisoned in the castle in Firienwood. Dire warnings are given in the instructions including a hint about needing magic.

When I started my trek through this adventure I was pleasantly surprised by the descriptions. They were descriptive! Included within these were the visible exits which was nice of MP. However, I was not so happy about the inclusion of *all* the compass points, up, down, left, right, in and out, giving a grand total of fourteen possible directions from any one room! This makes map-drawing difficult.

The game itself I managed to solve in about ninety minutes having visited only 55 rooms. I must admit that I scored only 120 points, but at least I freed the Bird! There is no indication of how many rooms there are and we really should be told. The only indication to how many points may be scored is that the maximum is some four digit number (120 being shown as





0120). There also seemed to be a distinct lack of objects spread around. I only found about eight or nine.

An intrepid adventurer will have to cross valleys and go through woods and tunnels, as well as searching a castle for the elusive Golden Bird. There is a good variety of location, though I did feel uncomfortable that there were many places where going in one direction and then going in the reverse direction did not always put you where you started. I've never believed in this illogical movement. It's unnecessary.

There are monsters, creepy-crawlies and evil goblins lurking in the dark corners of this adventure, which seem to strike randomly and are killed by the adventurer with random success (you get 10 points for each murder), again not a particularly good feature that caused frustration more than anything else.

However, MP have included a couple of good features in the adventure. HELP gives basic instructions for playing the game (though no hints) and so gets over any problems of forgetting the objective! There is an excellent save-game facility which is very, very fast (on a par even with the speedy Epic save-game).

On the whole this is a reasonable adventure which would suit an inexperienced player.

Ratings Table:

DOCUMENTATION	75%
VALUE FOR MONEY	70%
OVERALL	70%

Title	**Woodland Terror**
Publisher	**MP Software**
Machine	**Acorn Electron**
Price	**£7.48**

MP Software has produced the sequel to Firienwood, their first attempt at an adventure for the Electron. Though it is set in roughly the same scenery as its predecessor, Woodland Terror may be played without having either attempted or solved Firienwood.

In the first adventure of the series a genie was released from the magic lamp. This evil being is now terrorising the locals and it is your task to find the lamp and re-imprison the genie.

The adventure is technically very good. The response to input is fast and the descriptions of the locations are excellent. Coupled with a very quick save and load-game facility there is little to complain about from initial impressions. However I felt uncomfortable during the game due to the random element that MP introduced to the play in the form of ferocious goblins and greedy vultures that might attempt to kill on sight.

Too many software houses have jumped onto the "independent characters living their own lives" bandwagon and not dealt with it fully. I'm afraid that MP have paid lip service to this "feature" and made it repetitive without adding interest to the adventure.

The vocabulary included is good, the verbs and names having been well chosen with imagination and I'm sure that therein lies the secret of how to finish this adventure. How do I get past the giant ant? The baby vulture? The evil Genie. . .?

So far I have visited about 75 rooms but have yet to solve the adventure. Whilst I feel that I am close to the solution I have no idea how to go forward. (Does anyone know how to get out of the small room with the wizard's staff and hat?)

A reasonably good adventure. Whilst certainly not the best that I've played on the Electron, it's very certainly not the worst.

Ratings Table:

DOCUMENTATION	65%
VALUE FOR MONEY	80%
OVERALL	75%

Title	**Percy Penguin**
Publisher	**Superior Software**
Machine	**Acorn Electron**
Price	**£7.95**

Percy Penguin is an original game from Superior which needs a combination of speed, thought and manual dexterity (at least when using the keyboard and not joysticks) to attain a good score.

The aim of the game is to try and destroy Sno-bees whilst controlling Percy. Percy moves up, down, left and right on a grid which contains many ice-blocks. When Percy (or a Sno-bee) comes into contact with one of the blocks it may be pecked (and so disappears) or it may be flung across the grid to destroy any unsuspecting Sno-bee in its path.

Once all Sno-bees have been destroyed on a screen, the game moves forward into the next screen where the Sno-bees are that much more vicious.

I found this game extremely difficult yet compulsive. I wish that I could have used the joystick option since my befuddled brain could not cope with the five keys needed to control movement and pecking (maybe I'm getting old. . .).

After some hours play I finally managed to come up with a strategy that made it comparatively easy to get into the second screen. However at the moment I'm stuck there.

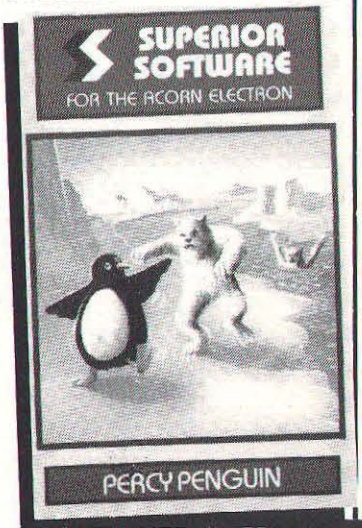
The graphics are good. But who has ever heard of a red penguin? Apart from this movement is swift, though in certain situations with many Sno-bees on the screen, response to key depressions could be better.

Throughout the game there is continuous music which is not common with Electron games. What it adds I don't know (who out there called me a wet blanket?).

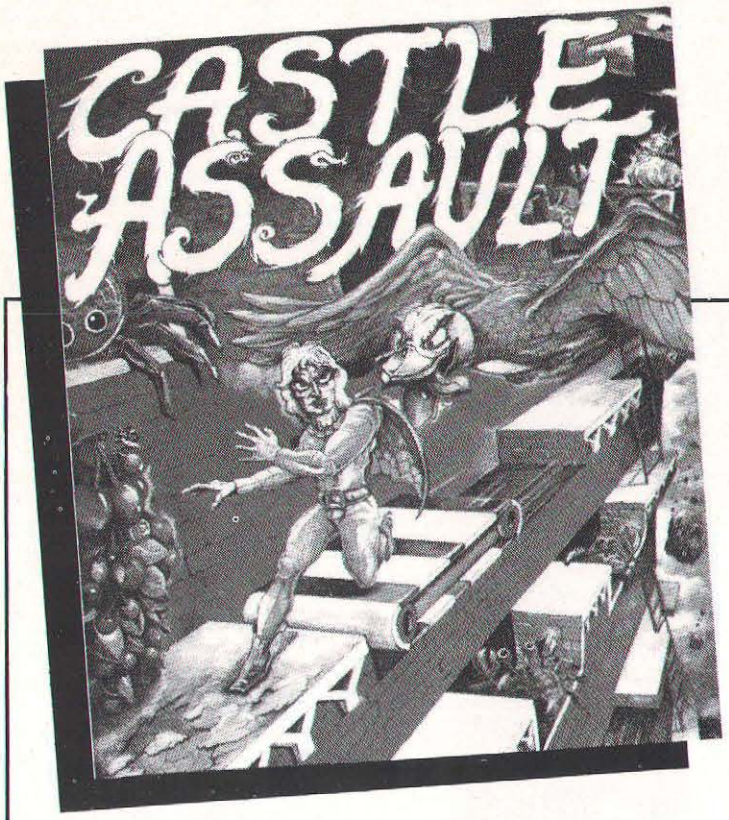
However the game is enjoyable and a challenge. As such it is a pleasant one to have on the shelf.

Ratings Table:

SOUNDS	90%
GRAPHICS	85%
DOCUMENTATION	80%
VALUE FOR MONEY	90%
OVERALL	85%



CONTINUED OVER



Title Castle Assault
Publisher MRM Software
Machine Acorn Electron
Price £5.70

The objective of Castle Assault is to go up the floors of a castle, jumping over monsters, climbing ladders and negotiating moving platforms. On each floor there are fruits which, when devoured by the little man under the player's control, earn points.

These points are hard to come by, not because the fruits are difficult to eat, but because they are difficult to get to. When the player reaches the top of the screen he gets a bag of gold which takes him into the next screen. These become progressively harder and so I haven't seen too many of them.

To make things more complicated, after the first level of difficulty there are birds passing above which knock you off if you let them. These are accompanied by rocks which might hit you and so also make your life a misery.

The graphics on this game are very competent with excellent smooth movement by the player's man. This game shows that even though the Electron is slower than the Beeb, it is still capable of providing the environment for some excellent graphics games.

One major disadvantage this program has is that levels of difficulty are not different enough to maintain interest.

Unfortunately for MRM this type of game is now commonplace for the Electron. So whilst it is competent it is not different enough to warrant buying if you already have Killer Gorilla or Ghouls.

On the whole, whilst Castle Assault doesn't have a lot wrong with it, it's not exciting enough to make an impact on the software charts.

Ratings Table:

SOUNDS	80%
GRAPHICS	95%
DOCUMENTATION	60%
VALUE FOR MONEY	70%
OVERALL	75%

Title Gunsmoke
Publisher Software Invasion
Machine Acorn Electron
Price £7.95

For those of you not old enough to remember, Gunsmoke is the name of a famous old Western television series. Software Invasion have taken the "shoot-'em-up" theme literally and produced a cowboy game.

The player is in control of a Wild West gunslinger facing a row of buildings (including a saloon, store and the mandatory sheriff's office). The player may control whether the gun is up or down (including a half-up position) and the left-right movement of the gunslinger. The object is to shoot any baddies (or are they goodies?) that appear at the doors and windows of the building opposite.

To be frank the game is boring once the basics have been grasped. Whilst the movements of the gunslinger are good (even though only in the left-right plane), the lack of imagination in what the player controls and the uncanny Exocet-like homing instincts of the opponent's bullets leads to the player losing interest very quickly.

The idea is obviously a good one. Perhaps developed along the lines of a two-player game with more freedom of movement it will lead to a winner. Unfortunately though, as it stands, this game will not go down in the annals of computer games' history.

Ratings Table:

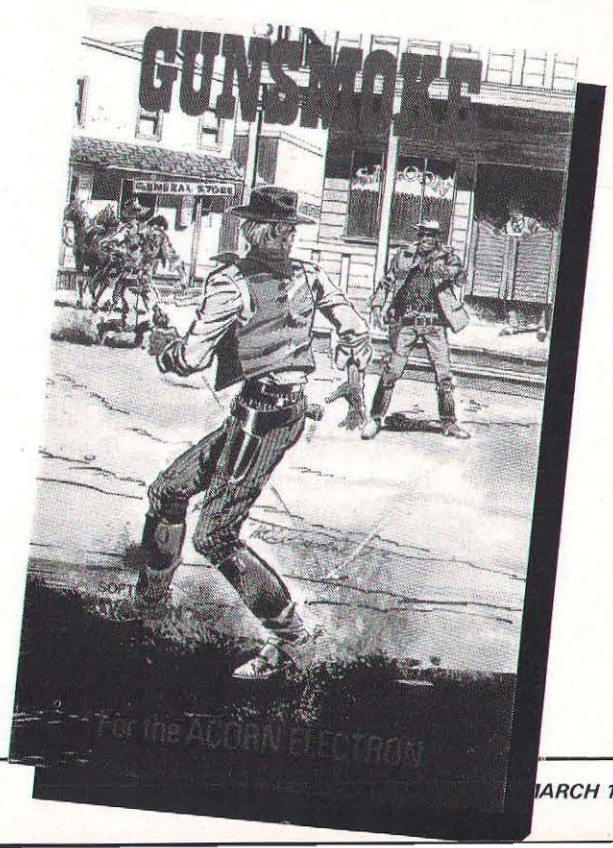
SOUNDS	60%
GRAPHICS	65%
DOCUMENTATION	70%
VALUE FOR MONEY	50%
OVERALL	55%

Title 3-D Bomb Alley
Publisher Software Invasion
Machine Acorn Electron
Price £7.95

This game seems to take its inspiration from a famous bay "somewhere in the South Atlantic". The morals of whether this should or should not be done are not for me to adjudicate on here.

The game has a static view of a bay surrounded by mountains. There are several ships moored in the bay (three to begin with) which have to be protected using anti-aircraft fire. The enemy's aircraft approach head-on, growing larger by the second and you, the anti-aircraft gun operator, have a cross-hair sight to help gun them down.

The aircraft come in waves — first ones, then twos and so on. Whilst reasonably easy to begin with, the game becomes more difficult with each wave. Whenever an aircraft gets through the obvious (but not necessarily realistic) happens and a ship is bombed and disappears. If you shoot down enough of the aircraft extra ships appear in the





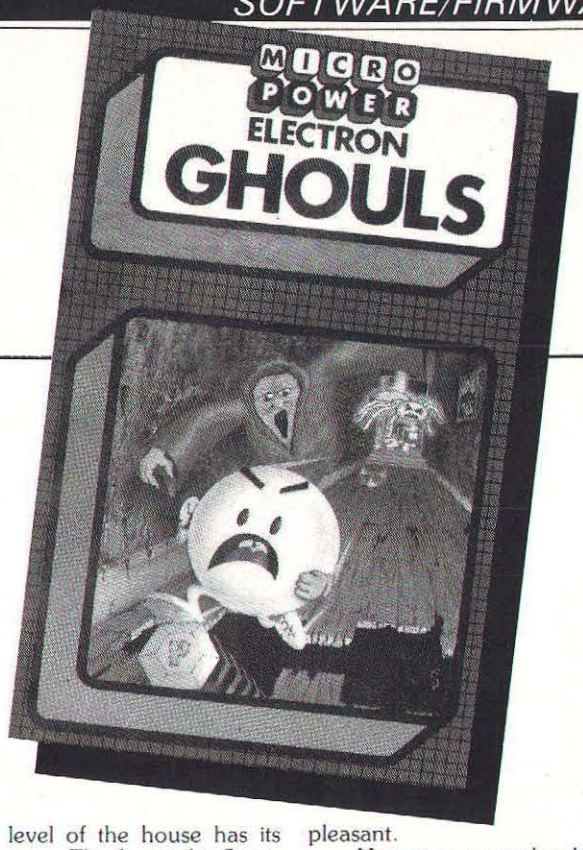
bay. When all the ships have gone the game ends.

The only distinguishable feature of this game is the effective 3D approach of the enemy aircraft. The static nature of the ships and the way that they appear and disappear shows no imagination on the part of the programmer.

Those of you with the "First-Byte" joystick may use it with this game. Good luck to you. I hope you enjoy it more than I did.

Ratings Table:

SOUNDS	75%
GRAPHICS	65%
DOCUMENTATION	65%
VALUE FOR MONEY	60%
OVERALL	55%



Title **Ghouls**
Publisher **Micro Power**
Machine **Acorn Electron**
Price **£7.95**

Ghouls is very much in the Killer Gorilla mould where a superbly animated little man is guided around a series of screens. The intention is to rescue power jewels from the horrid ghosts that stole them.

Each screen represents a floor of the house that is inhabited by the ghosts. The voyager will encounter cracked and contracting floor boards as well as the delightful moving platforms, springs and deadly spikes. Of course there is the mandatory nasty spider (making a detour from the multitude of adventures that he appears in) that is sick of eating flies and wants you.

To help the unsuspecting traveller there are various power jewels scattered around. Eating these gives an advantage over the meanies in that the ghosts temporarily disappear!

In playing this game I have managed to get to the third level (not very good I hear you say). Each level of the house has its own name. The first is the Spectres' Lair and with some practice becomes routine. The second floor is the Horrid Hall. This level announces the first appearance of the dreadful retracting walkway. The third level is the Spider's Parlour where the evil arachnid makes an appearance. As yet I have not reached him so I cannot comment on what depravity he will get up to. Knowing Micro Power it won't be pleasant.

How many more levels there are I do not know, but I'm going to keep on with this game long after I've finished writing the review.

Ratings Table:

SOUNDS	85%
GRAPHICS	95%
DOCUMENTATION	85%
VALUE FOR MONEY	95%
OVERALL	95%

Slogger Advanced Systems have joined the growing list of suppliers producing add-ons for the Electron. Their Rombox has been designed to allow ROM-based software and sideways RAM extensions to be used on the Electron.

The Rombox is solidly built and is a darker cream colour than the Electron. The unit fits flush to the expansion plug at the back of the Electron (where else?) and is firmly secured by means of two nylon 6mm screws. Further expansion is provided for by duplication of the Electron's expansion plug at the back of the Slogger unit.

Slogger have allowed for a maximum eight ROMs to be added in two groups of four. Pages 4, 5, 6 and 7 are provided for on the left-hand bank of sockets whilst pages 0, 1, 2, 3 and 12, 13, 14, 15 are optionally selectable on the right hand bank of four. By using three so-called option jumpers on the right-hand side of the unit various combinations of 32K, 64K, 128K ROM and 64K RAM in various pages may be specified.

SLOGGER ADVANCED SYSTEMS ELECTRON ROMBOX

There is no indication in the otherwise excellent instructions of how much of the Beeb's extensive ROM-based software will work with it. However when more ROMs are available for the Electron this will not matter.

Note that some ROMs suitable for the Electron have been announced. There are Electron versions of Beebugsoft's Toolkit and Exmon, as well as Starmon from Slogger themselves.

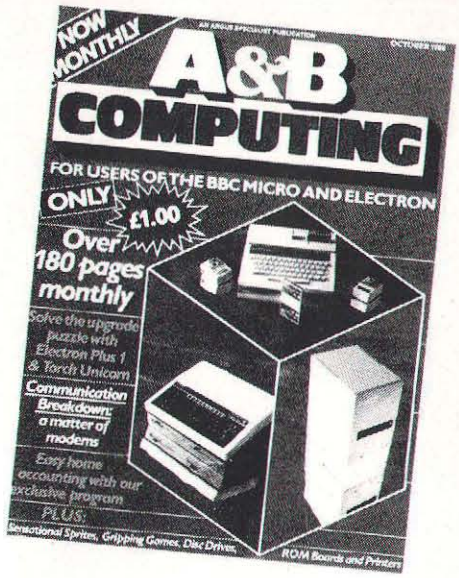


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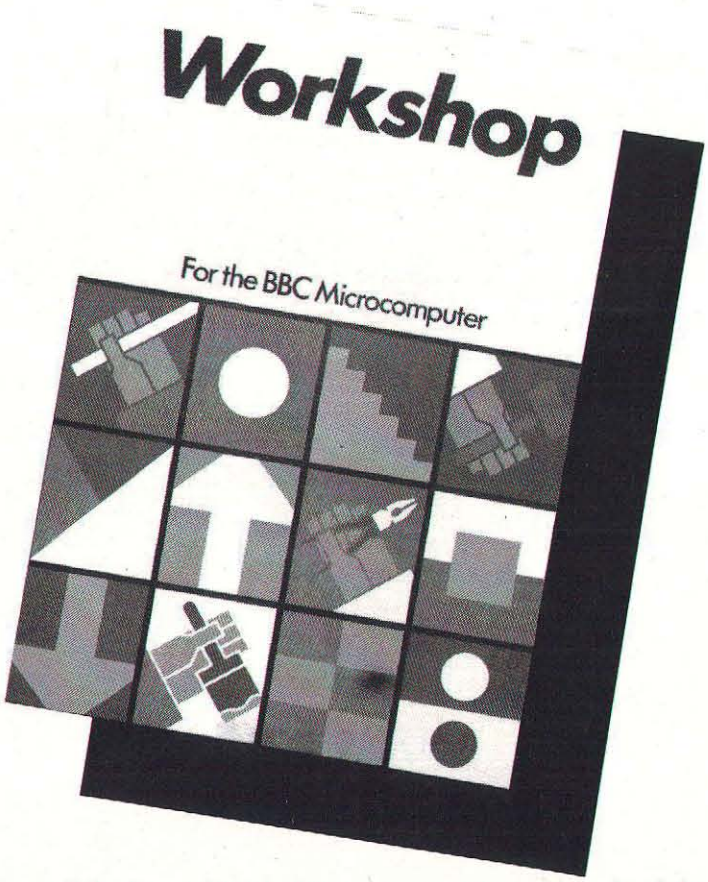
Signature . . . . . .

Date . . . . . .

Edsoft

Title Workshop
Publisher Acornsoft
Machine Model B
Price £9.95/11.50

Acornsoft's Workshop answers the critics of educational software.



The cries have almost inevitably begun to go out recently about the disappointing progress made in the field of educational software. A figure of 3.6 million has been put on the financial backing for microcomputer (amost entirely BBC) hardware in the Trade and Industry department scheme. But, where's the software?, the critics have started to shout.

Software of all standards takes time to develop and software of high quality needs field testing, revising, discussion between educationalists, programmers and publishers. And now perhaps the benefits of hard work and long hours is beginning to pay off. Experience of using micros with young children is beginning to show through in the new generation of programs.

Acornsoft's Workshop is one of these, suitable for home use or in the classroom, suitable for the individual child or for a bunch of children each contributing an idea in turn. Workshop is about investigation and experimentation.

The child is offered the opportunity of controlling a workshop full of interesting tools. Large colourful symbols represent the actions for paint, drill, scale, cut, squash, glue, rotate and look. The symbol for a shelf completes the function key strip which accompanies the program and makes selection dead easy.

The shelf page offers the choice of circle, square or triangle. Simply learned combinations of keys like Delete, Return, Copy and numbers 0 to 4 do all the swopping, cancelling and confirming required at this stage. The basic shape which has been selected is now ready for the machines!

The plan page displays the symbols for the machines (glue, drill etc) with the chosen shape in the main central box. The child can move the shape around the box and rotate it (in 90 degree chunks). When satisfied with the results the function keys move us on to the machines. Each machine has its own page.

At this point I must explain that every action taken by the child is being recorded by the computer. Each move is taking its place in a sort of program which can later be played back. This program can be viewed by moving to the look page. It's displayed as a series of machine symbols. Exciting isn't it?

The best bit is to come. The drill cuts ever increasing bits out of your shape. With cut, you choose the side of the shape you wish to lose and it is sliced off. Paint lets you recolour in any of the seven Mode 2 colours available after black background. Usually the Delete key undoes the last action, but on the paint page it undid them all and returned to the original colour of the shape.

The squash page also encompasses stretch. Select with cursor keys, up for stretch, down for squash and hey presto. All actions are accompanied by wonderfully appropriate noises (it's OK Des, they can be turned off!).

Glue shifts the shape sideways onto a new one and sticks them together. Fascinating. Scale is for bigger or smaller shapes. If you increase the size it tends to reduce back to its original shape. If you reduce, it is possible to reduce beyond the ability to reproduce the original. Increase again and you have a new, simplified shape.

Workshop is about play and experiment. There's no telling what you could find out, what shapes you could come up with. The "Not" page creates a shape in your box where once there was space and vice versa.

From the look page, all your actions can be replayed. A strange compilation sequence ensues followed by the replay in full. The program can now be deleted, but the shape you have created remains on the shelf, ready for further machining.

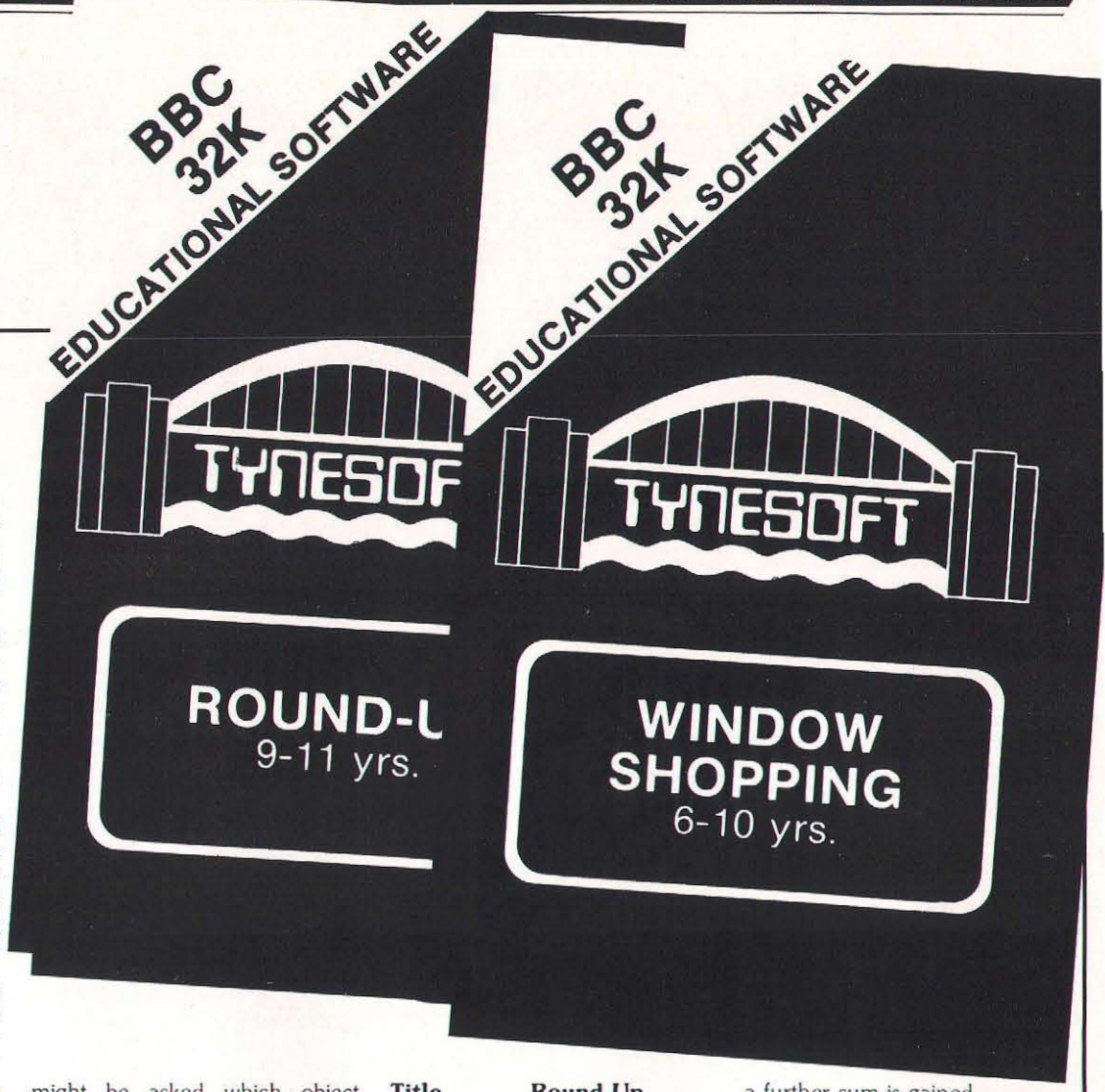
The manual which accompanies Workshop is brief and to the point. It does not need to explain key presses because the choices are always on screen — for intelligent guessing and experiment if you don't know what they do. Delete and Return are consistently used for Cancel/Confirm. There are some great sounds, high pitched squeaks and a very sonorous clang when you drop a clanger!

Workshop is real value for money educational software since its open ended nature will provide inspiration for children year after year. It offers an exciting opportunity for children to build and control a creative process and to observe it in action when they are satisfied with the job. It's one of many programs now answering the critics with imaginative and inspiring ideas, well implemented. **M.W.**

Ratings Table:

SOUNDS	90%
GRAPHICS	95%
DOCUMENTATION	90%
EDUCATIONAL VALUE	90%
VALUE FOR MONEY	85%
OVERALL	95%

CONTINUED OVER



Title	**Window Shopping**
Publisher	**Tynesoft**
Machine	**BBC Model B**
Price	**£9.95**

Tynesoft is yet another one-man set-up trying to get the tiniest of fingerholds in the educational market. Actually there is plenty of room for companies who produce *good* programs at reasonable prices and which merely claim to be an extra help to the teacher, rather than all the buy-this-tape-and-it-guarantees-you-at-least-three-A-levels-and-a-job-with-a-car hoo ha which is so prevalent today.

This tape isn't going to set the educational world on its head overnight, but equally it is a very competent attempt to bring a little more interest and enthusiasm to the learning of simple money manipulation.

The programming is actually quite fair, and belies the fact that it has been designed by a serving teacher. No insult intended to the profession, of which I am a member, but more a reflection on all the other pressures of time.

There are in fact a series of six related and complementary programs, use of some or all of which might be appropriate to a large number of children of primary age. Actually the author quotes six to 10 years, I would imagaine an even wider range might benefit. None contains a time element, and this allows less confident children to use plastic coins for reinforcement. All share a common system of input, with the spacebar being used to move the cursor from one box to another, while the Return key is used to select the required article.

In the programs a variety of objects are shown, nicely drawn, in a series of windows. Each is priced, up to 10p, with the letters and numbers clearly printed. Depending on the game, the child might be asked to select two or three items to total a given figure, or they might be asked which object could be purchased three times for 18p, for instance. Change One and Change Two involve deciding which objects must have been bought in order to leave a given amount of change from either 20 or 50p. Thus the children are in effect practising their number bonds in various combinations.

I found the children enjoyed using the programs and I believe they gained a better grasp of number relationships by doing so. But mainly they played around with numbers, used concrete coins to aid their thoughts and discussed their way to a logical conclusion.

All in all a very praiseworthy first effort, equally valid for use at home or with a small group at school. I just wish the Break was disabled! **P.T.**

Ratings Table:

SOUNDS	75%
GRAPHICS	90%
DOCUMENTATION	75%
EDUCATIONAL VALUE	85%
VALUE FOR MONEY	80%
OVERALL	80%

Title	**Round Up**
Publisher	**Tynesoft**
Machine	**BBC Model B**
Price	**£9.95**

Round-Up is an attempt to combine a game element with educational content, but it doesn't quite succeed in being good in either direction, sadly.

The educational point is to practise the skill of rounding up an answer to the next multiple of ten, and this is perhaps a slightly strange choice, being a fairly simple concept to grasp with more orthodox approaches.

The game resembles a poor man's version of Pacman with a little man scurrying around a maze collecting points (money) by passing a guard. When the guard is encountered, an addition or subtraction sum is shown at the centre of the screen, together with three "rounded" answers. The child has to touch Space when the answer is indicated which the child wishes to select. If two red guards are successfully passed and the Star Chamber is reached then a further sum is gained.

The standard Z,X, *,? keys are used to guide the figure through the maze, but there is no immediately obvious final point to aim for, no flashing point or even a little door. I found that the children soon became confused and then it didn't take long for them to get bored.

A wrong answer at any point brings about a rather premature end to the game, and I have never found that children do particularly well if they feel too much risk of failure.

A last, but perhaps salient point, was that the hi-score table refused to come into play for my children, even though they beat the boasted hi-score on the screen. To a child, there is no quicker turn off! **P.T.**

Ratings Table:

SOUNDS	55%
GRAPHICS	45%
DOCUMENTATION	75%
EDUCATIONAL VALUE	45%
VALUE FOR MONEY	45%
OVERALL	55%

Making the most of Logo

Ann Owen

Logo is the ideal language for beginners to computing. Join us for some turtle antics.

Welcome to Logo.

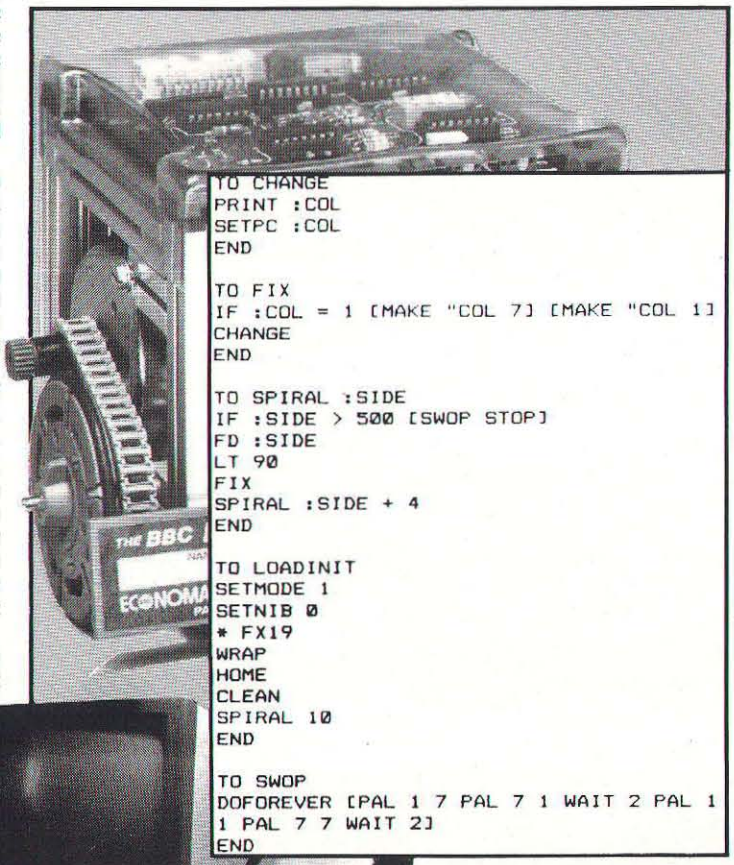
They really started something back in 1968 at the Bolt Beranek and Newman laboratory in Boston, Massachussets — Logo!

The famous one is Seymour Papert but there were two others in at the start, Daniel Bobrow and Wallace Feurzeig (he coined the name Logo). Since then numerous enthusiasts, programmers and educationalists have worked with the language and developed new versions.

Logo started as a simplified form of Lisp but took off with the inspired addition of turtle graphics while under development at MIT. Turtle graphics is now the trade mark of Logo and comes into its own with the use of robot turtles like the BBC Buggy.

A separate school of thought has developed a uniquely British, classroom orientated Logo ever since 1972. Rather surprisingly for the number one computer in British schools, it is only now that Logo is properly available for the BBC Microcomputer (and in the case of Acornsoft Logo for the Electron also).

This series intends to approach Logo from the point of view of the beginner to computing, to learn through using the various Logo primitives in our own programs. To be successful we will need feedback from our readers. We will publish their programs, procedure definitions and turtle graphics for the enjoyment of other readers (and we will pay!!). It should be fun.



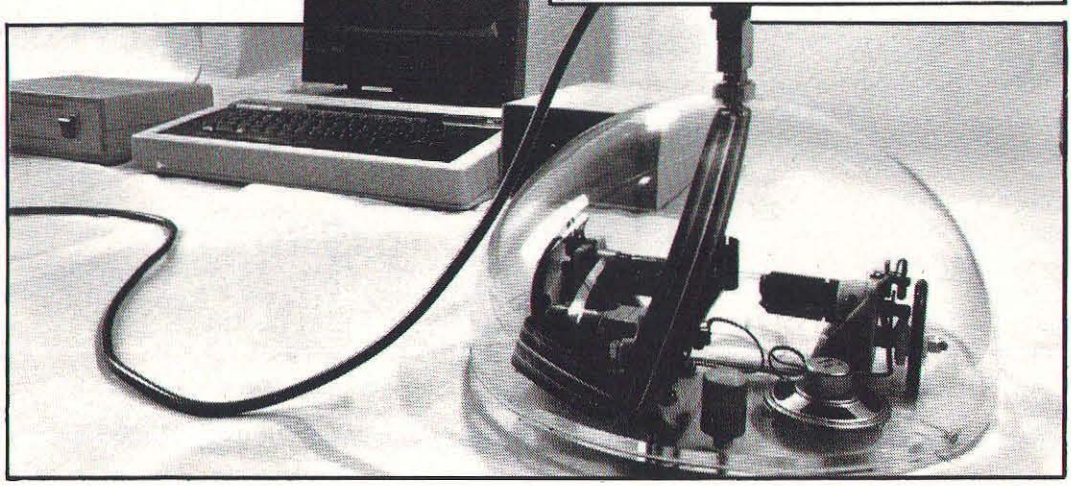
```
TO CHANGE
PRINT :COL
SETPC :COL
END

TO FIX
IF :COL = 1 [MAKE "COL 7] [MAKE "COL 1]
CHANGE
END

TO SPIRAL :SIDE
IF :SIDE > 500 [SWOP STOP]
FD :SIDE
LT 90
FIX
SPIRAL :SIDE + 4
END

TO LOADINIT
SETMODE 1
SETNIB 0
* FX19
WRAP
HOME
CLEAN
SPIRAL 10
END

TO SWOP
DOFOREVER [PAL 1 7 PAL 7 1 WAIT 2 PAL 1
1 PAL 7 7 WAIT 2]
END
```



LOGO CONTENDERS

After such a long wait we now have two main contenders bidding to supply Logo to us micro owners. There's Acornsoft Logo, reviewed in "Turtle Fun" this issue and LSL Logo, a 16K sideways ROM version of the language developed by Logo Software Limited with Catsoft. Catsoft, an independent research group in Bristol, completed a feasibility study for the Department of Industry to see whether a full Logo could be written in 16K. The answer was yes so they did it!

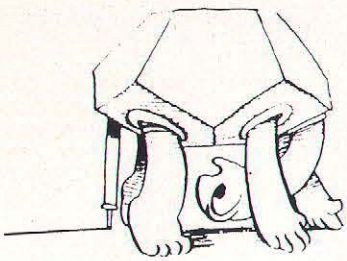
A&B Computing published its very own turtle graphics program (no way could it be called a Logo) back in the spring of 1984. If readers wish to find out a thing or two about turtle graphics before commiting themselves to a full version (LSL Logo costs £67.85 and Acornsoft Logo £69.00) then we are making it available for the bargain price of £3.00 (cassette), £4.00 (disc). Send your orders to us at Number One Golden Square, London W1R 3AB.

There's a lot to learn but Logo is far easier than other languages and still offers very powerful facilities, including the sort of list processing capabilities you need for implementing artificial intelligence type programs.

Everyone's first experience of Logo however is moving the turtle around either the screen or the floor. Our first program will concentrate on the screen. It is written in Acornsoft Logo (because that's the one available to me at the moment). It hatches a number of turtles, sets up their environment and gets them to draw some patterns. A nice simple start.

Turtle Fun

Ann Owen



Acornsoft claims to have produced the definitive version. What's it like to learn with Logo?

Logo at last! The BBC has its share of "subsets", restricted to user memory usually, and ironically written entirely in BASIC! Now both the Electron and BBC Micro have a true Logo language, courtesy of the efforts of Acornsoft and their collaborators RCP Ltd. Numbered amongst the supervisors of Acornsoft Logo development are Richard Noss (Editor of the British Logo Users Group magazine), Mike Thorne (University College, Cardiff), Professor Celia Hughes (London University, Institute of Education), Dr John Laski and the MEP.

LEARN WITH LOGO

I consider £69.00 a lot of money for computer software. Wait a minute though. On reflection, lessons in a modern European language would come more expensive and so would a computer language evening course. Acornsoft Logo caters for no one if not the learner.

The two 16K "sideways" ROMs in which Logo is housed are backed up with Logo extensions on disc (40 convertible to 80) or cassette, a 163 page manual, an introduction to Logo, a guide to the extensions and example programs and a reference card.

Among the extensive instruction on fitting the language ROMs, the one thing I could not find was advice on which way round the ROMs should go in. Common sense indicated that ROM one should go in the higher priority socket and this is indeed the case. Somehow, in the rush to get out the review copies I'm sure, the labels on my ROMs had been mixed up! No problem. If your BBC or Electron screams as though someone has just trodden on its ULA then turn off and swop the Logo ROMs/cartridges.

TURTLES ARE HERE

You now have access to the second most "known" computer language, the brainchild of Papert, subject to investigation by BBC Two's Horizon and second only because BASIC has forced its way into people's homes under the bonnet of many a popular micro.

The first thing that strikes you about Logo is its visual appearance. On entry only the bottom six lines of the Mode 4 (default on entry to Logo) screen are initially available for text. The rest is a framed window (graphics area) with the turtle shape resting in the centre pointing up, the home position.

The first commands (primitives) you learn are the easiest, the ones that move the turtle around. Seeing the results of your own input instantly performed by the turtle is a tremendous incentive to find out more. Barry Morrell's excellent Introduction and User Guide (in practice if not in name) soon start to take on the ragged appearance of a favourite thriller.

It's impossible to go through all the primitives of Acornsoft Logo or to describe in brief the entire scope of what Logo achieves as a language. We have not listed the primitives for you but what follows is a personal account of getting to know Logo. This will continue on a regular basis in "Making the Most of Logo", a series we hope will run and run in ***A&B Computing***.

Anyone who wishes to contribute to the series with comment, advice or examples of Logo programming is very welcome to do so.

The world of Acornsoft Logo can be easily manipulated by various commands for choosing Mode, choosing foreground (SETPC — set pen colour) and background colours, changing the palette (PAL — equivalent of VDU 19), choosing graphics effects (SETNIB), manipulating screen size and shape and the turtle itself.

As well as controlling the turtle there are a multitude of commands for checking up on where it is, how far away it is, its coordinates, whether the pen is up or down and what its current shape is. You can also monitor its environment, the screen Mode it is in and what colour it is standing on.

The turtle can operate within the screen boundary (FENCE), can wrap around to the other side of the screen when going off one edge (WRAP) or can just keep on going within the territory of WINDOW. This allows the turtle the run of about 20 times the size of the screen, or 10,000 steps from the home position before it wraps around to the other side.

PRIMITIVES NOT BASICS

Primitives are the words typed into Logo by the user to make things happen. The first thing you do with the turtle is to move it around, FORWARD (FD), BACK(BK), to turn it through an angle RIGHT (RT) or LEFT (LT). Primitives can have an immediate effect or they can be incorporated into named procedures which effectively become new Logo primitives or words. The procedure is begun by typing in TO followed by the name. For instance TO SQUARE.

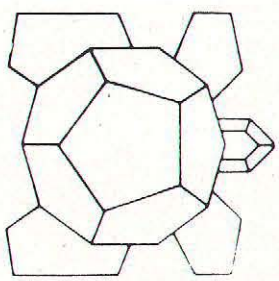
At this point the cursor changes to > to indicate that you are defining a procedure. You END this sequence. Logo remembers your procedure and there is a very easy to use bunch of primitives to edit with. You can edit procedures and names individually or as a whole.

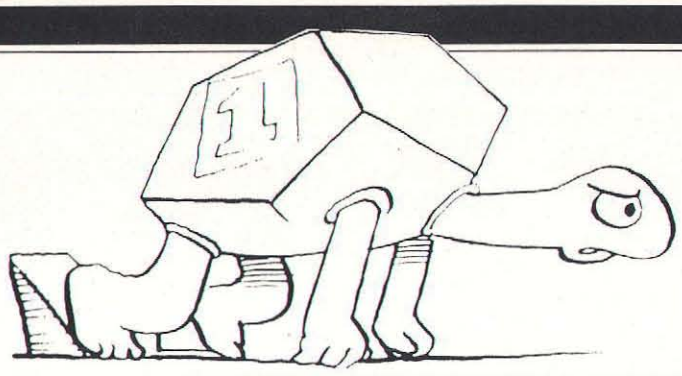
NEW EDITIONS

Logo has a complete edit screen for these actions. It's much easier to use than the cursor keys and COPY combination needed with BASIC. It's a bit like using a word-processor. The cursor keys move you around the lines of the text to be edited.

Combinations of CTRL (BBC) and FUNC (Electron) and cursor keys, N (insert line), D (delete character at current point), L (delete to end of line), U (delete line), provide all the functions for editing, Copy tells Logo to remember the new code, Escape tells it to forget the amendments and return to the original.

Other useful primitives report on and erase definitions of procedures and contents of variables. You can find out available and used workspace, load and save all or some procedures and variables, save and





load pictures, catalogue and manipulate files. These primitives have wonderfully apt and obvious names and abbreviations like ERASE, READPICT and WS (Work-Space). Even if you have mislaid the manual it is usually possible to work out what a Logo primitive does from the name.

TIDY is a particularly interesting primitive which clears out early versions of variables and procedures which Logo no longer needs to consider. Using TIDY improves the speed at which Logo can then perform.

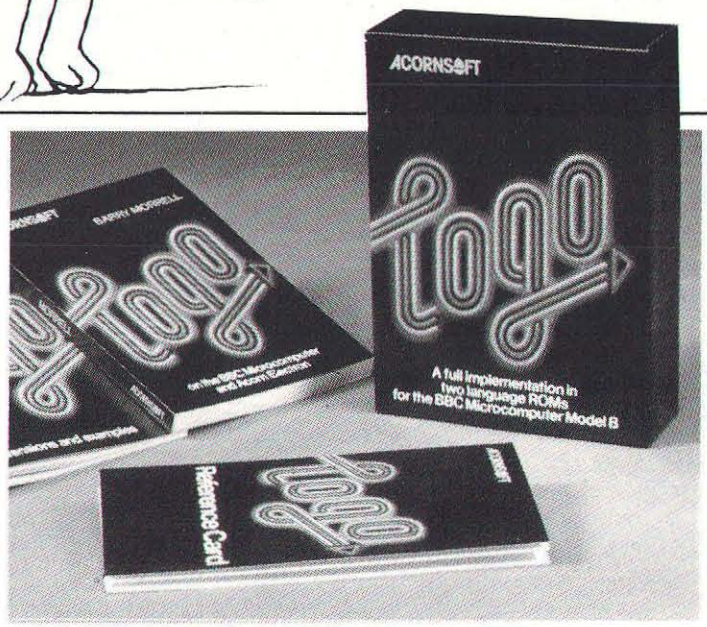
Procedures names can also be changed and tested (COPYDEF, DEFINEDQ). Variable names can be checked (THINGQ), contents checked (THING) and variables made local (LOCAL).

BEST OF BOTH

One of the most impressive features of Acornsoft Logo is the easy way in which it interacts with the familiar BBC Micro and Electron facilities. It hooks into the operating system for sound, graphics, keyboard scanning, control of floor turtles and buggies, printing screens, sensing joystick control and so on.

The built in printer dump routine is an important facility for reproducing turtle graphics for use away from the computer. It dumps both graphics and text areas. SOUND and ENVELOPE work as in BASIC except with the familiar commas giving way to Logo's own conventional spaces.

VDU commands are also available direct from Logo and VDU23 is especially important for defining the turtle's shape.



TIME (which works in tenths of a second), TIMERSET and WAIT are useful features for controlling program flow.

The programmer also has access to simple debugging and error trapping primitives. I don't think we will find too many independent companies developing program aids for Logo! CATCH runs a list of instructions if an error occurs (equivalent of ON ERROR). PAUSE and CONTINUE go together to make checking variables and so on easy. TC displays name of procedures called and there are sophisticated TRACE facilities, including single stepping through the program.

On the maths side especially useful primitives are SETDECS, which controls the number of decimal places being used, QUOTIENT and REMAINDER (DIV and MOD), SUM, SQRT and PRODUCE, which is a greedy version of *. INT returns the integer part of the number, ROUND rounds it to its nearest integer.

When it comes to words rather than numbers, Logo is very much more powerful than BASIC and therefore much more suited to the beginner (or even the human in general). ADDITEM, ERITEM and ITEM insert, delete and return value of elements in a list or word. BUTFIRST, BUTLAST, FIRST, LAST all return specific elements of objects. CHAR, COUNT, CAPS, ASCII, LISTQ and EMPTYQ are also useful and a simple wordprocessor could be amongst the first Logo projects you might try.

Here's a quick look at how these primitives work with a word:

```
PRINT LAST "A&B COMPUTING G
```

with a list:

```
PRINT LAST [A&B COMPUTING] COMPUTING
```

SENTENCE is a handy compiler of words into lists. A poetry generator perhaps? Not too difficult with Logo.

EXTENSIONS

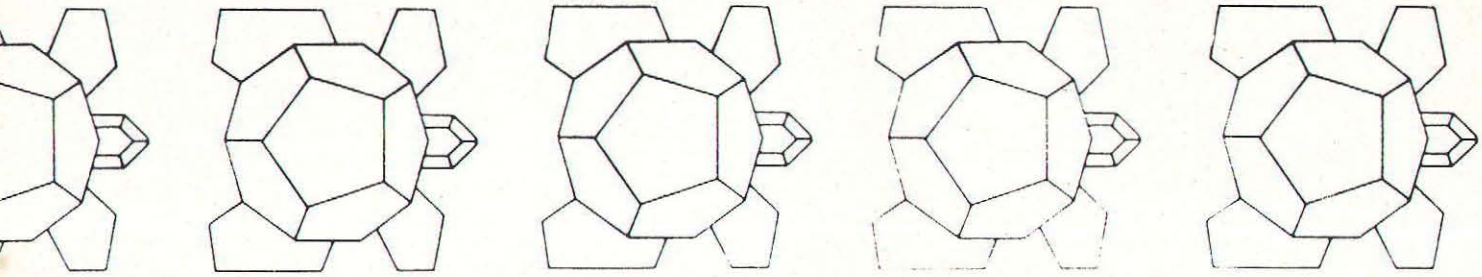
As if there wasn't enough in the two 16K ROMs, you also get extensions to the language. They extend the print screen, floor turtle options to specific models, Epson, Olivetti, Jessop, Valiant and Economatics Buggy. CALC provides for mathematical functions, some of which we have mentioned, MOS gives operating system primitives, MULT allows for multiple turtles, PROP provides property lists. SECT is a sector drawing primitive. The extensions are simply LOADed into Logo like any other program. A third separate manual details the extensions alongside the example programs which come on tape and disc. These programs are a good mix of what Logo can do and will form the basis of both learning and teaching the language. Nothing has been left to the purchaser.

IN ALL

It is difficult to summarise the experience of using Logo. It is certainly a nicer experience than using BASIC. It is not simply that there are more commands. Logo guides you into a way of programming which feels very forced when tried in BASIC but which results in understandable, easily adapted code.

Acornsoft's Logo is a very good version of the language and most of all makes complete use of the facilities of a standard BBC Micro or Electron and of other educational hardware.

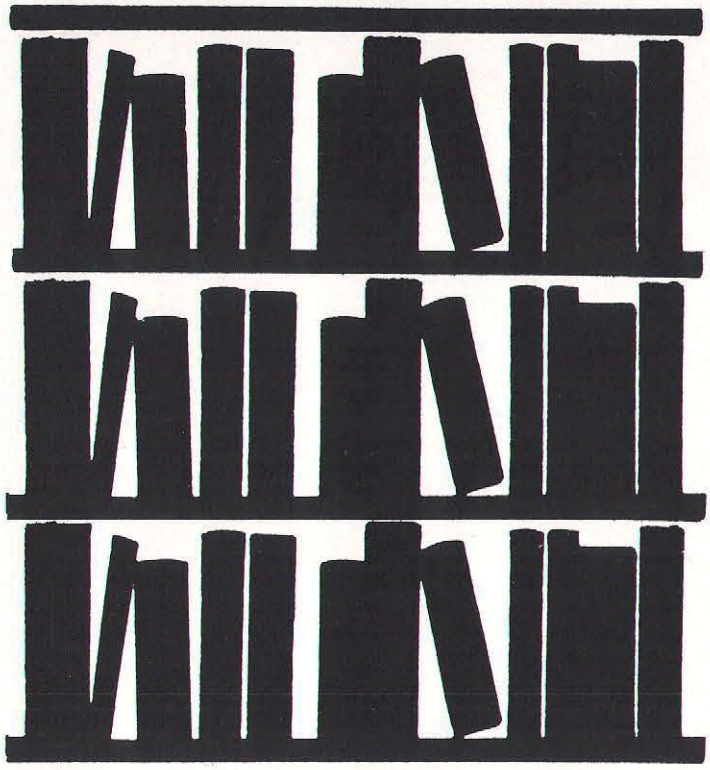
As with BASIC, there are plenty of trap doors into the O.S. and into other memory mapped areas for extended hardware options.



Why Not Start

Alan Rowley

An assessment of the Guardian Software Library Manager ROMs.



The ability to set up some kind of library file structure is a common feature of main frame systems. The facilities provided may vary but the essential feature of a library file is that, whilst appearing to the main computer filing system to be only one file, it actually consists of a collection of smaller files, each described as a "member" of the library. In order that the user can manipulate the library a piece of software called the "library manager" has to be provided. The manager software "understands" the internal structure of the library file and allows you, at the very least, to add new members to the library and to make deletions. Commonly, however, the manager will provide more sophisticated library manipulation facilities, perhaps letting you link files together or interchange information between files. The libbrary manager operates, in a sense, like a second level filing system *within* the main computer filing system.

Library files can be put to a variety of uses, perhaps the commonest is the creation of "project files" containing all the code and documentation for a specific program, a very tidy arrangement. As you might guess from this, the member files in the library need not be all of the same type, you can freely mix source code, text files, object code etc.

STRAINING AT THE FILES

By now I should think that some of you who have been straining under the 31 file straight jacket provided by Acorn are beginning to get hopeful. Imagine being able to put lots of small files, a few hundred even, into one big library file and so make the Acorn DFS think that there is only one file in the disc, you could then use the full storage capacity of the disc. Well you *can now*, this is exactly the facility provided by Guardian Software's library manager package, including the ability to set up a library of BASIC procedures from which you can draw a selection to be automatically "stitched" together as the basis of a program.

You will, no doubt, have already formed the impression that I like this package, and I certainly do, but let us look at it in some detail. The cost is £36.00 and for this you get two 8K EPROMS, one containing Source Library Manager (SLM) and the other with Text Library Manager (TLM). The manual explains that the option of using a 16K chip was discarded on the grounds of the additional cost but it might have been nice to have had the choice in these days of proliferating firmware, my extension board is certainly getting very full. Both chips will stand alone, however, so you can use a cartridge system with them.

Essentially the SLM chip contains all the routines for handling BASIC and ASSEMBLER source code, in other words anything that you would normally handle with the ordinary BASIC editor. TLM is used for everything else, data files, text files from word processors, machine code files etc. You have to select the appropriate chip, with *SLM or *TLM, for dealing with additions to, or retrievals from the library but you can freely mix the file types within the same library and most of the library maintenance functions are available on either chip so the amount of swapping about is minimal.

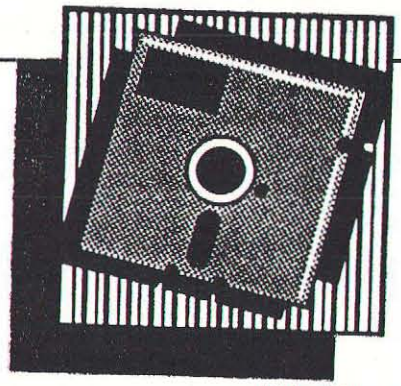
The manual is very much of the type that you need to fully digest before starting to use the package rather than a step by step guide but it is very clear. A particularly refreshing feature is the way that the author takes trouble to outline the sequence of operations followed by the manager when carrying out its various functions. This adds considerably to the ease of understanding.

Before you can start to build your library you have to prepare a disc, which must be formatted to an Acorn compatible standard with the catalogue in the first two sectors only and must be completely blank. Double catalogue formats are not allowed. If you choose to have a library which occupies the whole disc then you can have 199 files on a 40 track and a massive 399 on an 80 track. You can, however, opt for a library smaller than this but still retain the option to extend it at a later date if required.

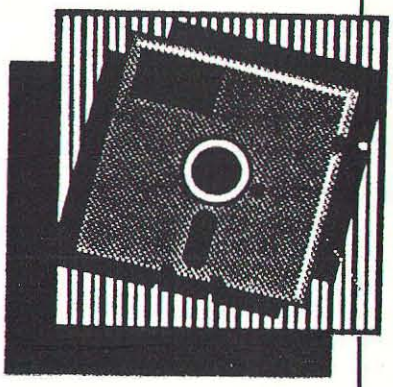
FEATURES IN THE SOURCE LIBRARY MANAGER

The SLM deals purely with BASIC and ASSEMBLER source code. To add a piece of code to the library you simply load it as normal, under BASIC, select SLM and then choose the appropriate option from the menu presented. You must give the code a library member name of up to eight characters but you can also add a 20 character description as well. What happens when there is already a member of the same name in the library is especially useful, since SLM does not overwrite the old version, it retains it and gives the new version a unique version number. The old version is marked as "deletable" but not actually removed and can be re-activated at any time. This process can be repeated until you have up to 99 versions under the same member name so that you can retain a complete history of the development of a particular piece of software. It would have been an improvement if the author had included a routine to issue a warning as to whether a file name was new or not. I did occasionally find that I mistyped and started new sets of files unintentionally or added a file to the wrong list. The situation is easily rectified but a little aid to thought would have been welcome!

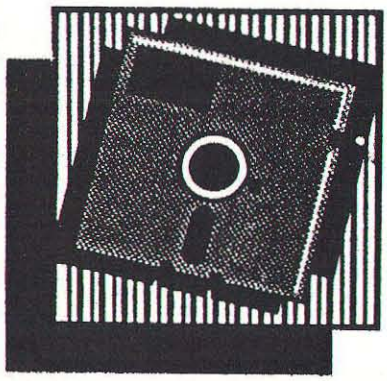
a Library?











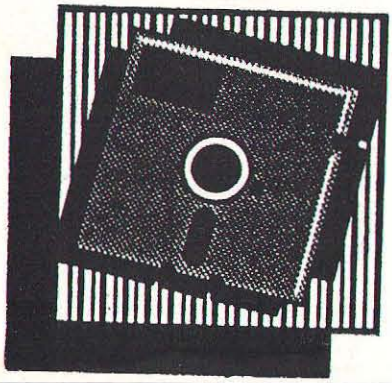


Library members are retrieved into memory and then can be RUN as normal after returning to BASIC.

The really exciting feature of SLM, however, is its ability to stitch together procedures. Having built up a library of subroutines all you have to do is to create a "definition" file, which is just a list of the member names of the pieces of code that you want to use. You then select the appropriate menu option and SLM collects together all the bits, sorts out any line number overlaps and renumbers. When you return to BASIC you find that the program is ready for you to add the main control structure. As far as I am concerned this facility alone is worth the cost of the package, * EXEC in my DFS is acquiring the electronic equivalent of rust through lack of use.

The final touch in SLM is a routine which lets you "reduce" a program by removing all comments and redundant spaces. You can, therefore, store a program with full documentation and retrieve a version which has been stripped of the REMs and backlash comments for actual use. This is especially useful for assembler source code which needs to be heavily commented if you are to make sense of it in the distant future.





FEATURES OF TEXT LIBRARY MANAGER

TLM of course lacks all the features of SLM which specifically relate to BASIC. It essentially only lets you store and retrieve files. You have the same ability to keep 99 versions of a member with only one version current and the library management works in an identical manner.

TLM, however, unlike SLM, does not take new library members directly from memory but expects to load them from disc first for transfer to the library file disc. This inevitably requires some well timed disc changing if you only have one drive. In practice this gave no problems but multiple drives are a distinct advantage. You cannot use a file directly from TLM, you have to recover it from the library onto another disc for normal use. TLM is essentially a backup library, therefore, and not for working from directly like SLM.

A particularly attractive use of TLM is as an archive store for word processor files which are often relatively short but numerous and are usually of interest for historical reasons rather than needing to be immediately available.

LIBRARY MAINTENANCE FUNCTIONS

These are accessed from a second level menu, which is the same within SLM and TLM. It is to this menu that you must go to see the member catalogue. I found this a rather unsatisfactory aspect of the package, it would have been much more convenient to have an option on the main menu which displayed the file catalogue, since you need to consult it fairly often. The catalogue select routine also perpetrated one of my favourite hates; when you select it it asks you whether you want hard copy, every single time! Why oh why not a toggle on the menu to select and deselect the printer? After all you are only likely to want a print out occasionally.

The other facilities from this menu are concerned with tidying up the file by discarding unwanted material. You cannot delete current versions of files, only those marked as deletable, so you shouldn't have any accidents.

Having deleted material you can then select a menu option to close up the spaces in the library, a process equivalent to * COMPACT on the DFS.

CONCLUSIONS

This is a very impressive package and excellent value. If only regarded as an escape from the 31 file problem it is attractive enough, since it completely circumvents any worries about changing to a possibly troublesome non-standard DFS, but when you add to this the facilities in SLM for handling BASIC code it is a real winner. I have found no bugs so far and since no user memory is used there are no interaction problems with other ROMs. The final point to be made is that SLM and TLM are both totally compatible with the 6502 second processor. Other firmware producers do please take note!

Down to Business

Can the ABC range compete in and for your business?

A few weeks ago Acorn had full page adverts in the national press that described the BBC computer as "the first choice for small businesses". An ambitious claim but is it true? Everyone agrees it is a joy to the home user and excellent for education but, with its tiny memory, can it ever really be a business machine? If so, why has Acorn bought out the ABC range of business computers?

This article helps you to decide what you need from a business computer, compares the BBC with others, looks at how much you will actually spend to get started (often a very different figure from the one advertised) and tackles that nightmare question:

"Should I hand my Beeb over to the kids and start off afresh with a real business computer, before investing any more in a machine that will never really quite make it?"

While we are about it, since Acorn are being so slow to release prices for the ABC range, we will be a bit cheeky and tell them. Finally we will discuss the merits of "the Upgrade Path", the secret of computerising your business without strangling it in the process.

I shall not therefore try to compare the merits of each machine in detail: that would give my readers indigestion and manufacturers apoplexy. However during 1985 this column will put all the "BBC business family" on test: the GRADUATE, sophisticated members of the TORCH UNICORN range and the new ACORN ABCs as well as hard discs. I shall try and keep you up to date with the continuing flood of new accounting programs and, if time and the editor's budget permit, describe one or two businesses who are using the BBC "for real". So, a happy and profitable 1985 to all business readers — its going to be an exciting year. Meanwhile, down to business!

FOUR LEVELS OF BUSINESS MICRO COMPUTER

This column's readership ranges from school fifth formers who do paper-rounds to experienced managers and lecturers in accounting at universities and polytechnics. To satisfy you all we shall therefore consider the computer needs of no less than four levels of business:

— The simplest of all. The one-person business below the VAT level. I have called it the MILK-ROUND but it might cover the jobbing gardener or "earnings on the side" (such as occasional buying and selling of antiques, renting out a flat or holiday cottage) or even just household book keeping and budgeting designed to save enough to get to the Costa-Brava next summer. Apart from any special programs such as an income tax calculator, software needs are limited to book-keeping, spread-sheet planning and perhaps a simple data-base. Each program will probably be between 10 and 20Kb long and will handle only very small quantities of data. Low cost is more important than speed or sophistication.

— The proper one person business, probably (but not always) fully "VATable". This is for the self-employed plumber, freelance photographer or water diviner who has to do both the work and the books. Presentable business letters, estimates or invoices may be needed, plus a set of books that will keep the tax-man and VATman at bay. Programs may be longer, perhaps 30Kb, and broken down into sections small enough to be held in memory. Because I have called it CORNERSHOP, to give the correct idea of size, does not mean it will not need a sales ledger. This is where the "small businessman's burden" lies heaviest — many transactions, each with paper-work, but all of them for small sums.

— The enterprise with a fulltime manager plus other workers. I have named it BUILDER to indicate that one or more of the main tasks is substantial: a payroll of up to twenty people, stock control of a small warehouse or sales ledger with twenty or a hundred customers accounts. Above all the books, solely for which a part-timer may be employed. Most, but not all, software needs to be "professional" with programs of 50 or even 70Kb and significant capital expense is justified if it will save time and improve profitability.

— Finally the full-blown business, often with manufacturing or processing as well as commercial functions, so I have called it the FACTORY. Inventories may be several thousand items, payroll, customers, suppliers, and cost codes may be in the hundreds. Five years ago it would have spent £50,000 on a mini-computer, now a micro can do it for a fifth of that, provided it can expand and expand and expand as the need arises. So in the tables I have included not only the basic product but also the "top of the range". Even then further expansion will usually be possible, by networking or linking to other systems. Cost is usually secondary to power and versatility. These computers may be asked to:

* Run concurrent programs on one screen at the same time, usually in different "windows". For example a report (being word processed) on a new sales product; a spread-sheet that shows the first year's order for it, analysed by customers; and the sales ledger from which that spread-sheet is being compiled.

MEMO

To: Chris Curry, Managing Director of ACORN

From: John Vogler, Business Correspondent, A&B COMPUTING

SUGGESTED PRICES FOR ABC RANGE

- The PERSONAL ASSISTANT should cost around £1800 all-in (ie with printer, stationery, discs and a full set of software including accounts). You should price the machine at £1100 including VAT and include an effective database.
- The ABC100 should form an all-in system costing under £2000. Price your machine, with a full bundle of PLAN software including ACCOUNTANT, at about £1600 including VAT.
- The ABC110 needs a competitive price to make up for its shortage of processor memory. It could be offered, with a monochrome screen, at £3000 including VAT.
- The ABC310 should form part of an all-in business system costing £6000. If you do not bundle in top quality integrated accouting and payroll package then the price should not exceed £4800 including VAT.

P.S. Press releases talk about "black and white" screens. I trust green will also be an available option.

MEMO

To: New Managing Director at Torch

From: John Vogler, Business Correspondent, A&B COMPUTING

PROFESSIONAL KEYBOARD FOR ENHANCED BBC

Only one thing spoils your range of professional enhancements for the BBC — the lack of a proper keyboard.

TORCH could easily produce a simple package as follows:

— Make a blanking-plate, complete with keyboard connector, to replace the BBC's keyboard. This should have mounting points for your Z80 board, and, even better, for additional 64K and 128K RAM memory boards.

— Take the keyboard "box", complete with cable, from the TORCH C Series. Retain the numeric keypad on the right and the dedicated word-processor keypad on the left but omit the central QWERTY keyboard and slightly alter the aperture.

BBC owners can then transfer the keyboard from their existing machine to the TORCH box, giving a professional, detachable keyboard at minimal cost. The BBC remains as a (more capacious) central processor, that can conveniently sit beneath the monitor. Such a package is a consistent part of the BBC/TORCH range and will encourage a new population of customers for the Z80, for the GRADUATE and for the UNICORN.

MEMO

To: All Managing Directors

For the one person business the BBC micro is as good as anything else available and better than most.

For the small firm its flexibility and the low cost of hardware and software make it fully competitive.

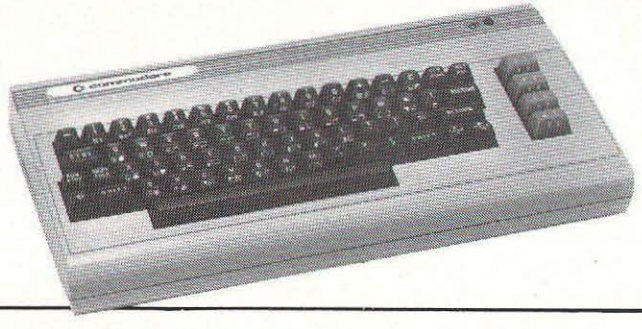
For the medium company the BBC with IBM-compatible GRADUATE G800/2, enhanced if necessary with hard discs, has only one drawback: lack of an adequate keyboard.

If further expansion is envisaged, and if UNIX-BASED software is suitable, the full TORCH UNICORN enhancement offers enormous computing power at realistic cost.

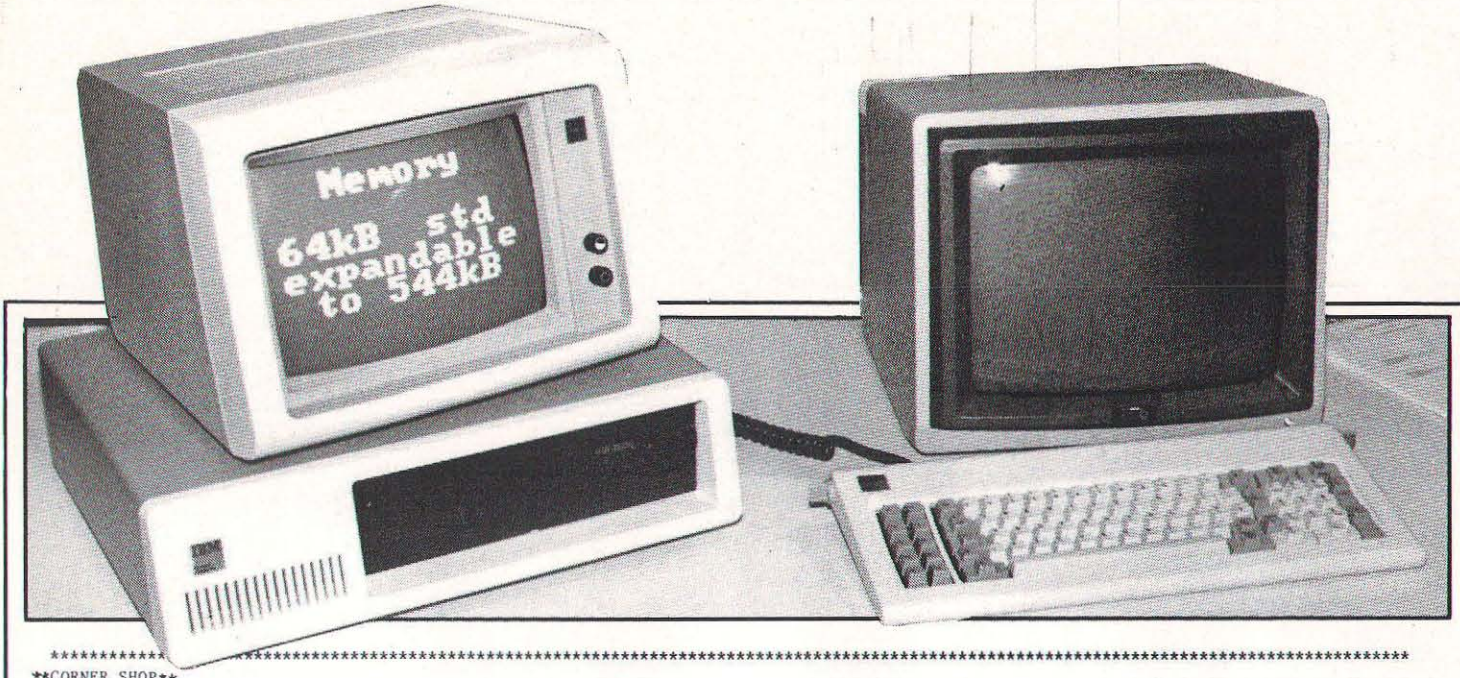
With TORCH and ACORN combined in commitment to business computing, the BBC range can be regarded as a serious business option; particularly if the cash-flow and other advantages of a modest beginning, followed by progressive up-grading, are more important.

MILKROUND

BBC-B	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: 15 user definable keys
*****	Processor	470.00	Cashbk + Accnts	GEMINI	95.00	Memory	32K	Plenty of low-cost software & add-ons
	Monitor	100.00	Database	DBASEBEEB	9.95	Discs	100K	Excellent BBC BASIC
	1X100K Disc drive	115.00	Spreadsheet	GEMINI BEEBCALC	19.95	Clock	2MHz	Screen 80 X 32 lines
	Printer	150.00				Word size	8 bits	Flexible for connecting hardware
	Stationery	30.00						
ALL-IN COST								DISADVANTAGES: No numeric key-pad
989.90	HARDWARE COST	865.00	SOFTWARE COST		124.90			Small memory limits power
COMMODORE 64	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: Plenty of software
**********	Processor	199.00	Spreadsheet	CALC RESULT	50.00	Memory	64K	
	Monitor	100.00	Database	SUPERBASE	99.00	Discs	175K	DISADVANTAGES: Limited BASIC language
	Disc drive	199.00	Accounts	ANAGRAM CASHBK	65.00	Clock	1.4MHz	Only 8 function keys
	Printer	150.00		ANAGRAM LEDGER	65.00	Word size	8 bits	Only 40 column screen display
	Stationery	30.00						(80 col adaptor costs 50.00)
ALL-IN COST								No separate numeric key-pad
957.00	HARDWARE COST	678.00	SOFTWARE COST		279.00			
SINCLAIR	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES:Huge memory
********	Processor	399.00	Spreadsheet	QUILL ABACUS	incl	Memory	128K	Very fast and powerful processor
QL	Monitor	100.00	Database	QUILL ARCHIVE	incl	Mic-drive	200K	
**	Micro-drives	incl	Accounts	None available		Clock	7.5MHz	DISADVANTAGES: Micro-drives slow
	Printer	150.00				Word size	pseudo	No accounts software available
	Stationery	50.00					16 bit	Little other software available
ALL-IN COST								No separate numeric key-pad
699.00	HARDWARE COST	699.00	SOFTWARE COST		0			



CONTINUED OVER



CORNER SHOP

BBC-B	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE	CAPACITY	ADVANTAGES: 15 user definable keys
*****	Processor	470.00	Word-processor	WORDWISE	37.00	Memory	32K	Wide range of low-cost software & add-ons
	Monitor	100.00	Database	DATA GEM	129.95	Discs	400K	Excellent BBC BASIC for self-programming
	2X200K Disc drive	200.00	Spreadsheet	ULTRACALC	79.50	Clock	2MHz	Screen 80 X 32
	Printer	250.00	Accounts	GEMINI INTEG	399.80	Word-size	8 bits	Flexible for connecting hardware
	Stationery	50.00						
ALL-IN COST								DISADVANTAGES: No separate numeric key-pad
1716.25	HARDWARE COST	1070.00	SOFTWARE COST		646.25			Small memory limits power

IBM - PC	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES
********	Processor	1819.00	Word-processor	EASYWRITER	176.00	Memory	64K	Wide range of software available
SMALL	Monitor	214.00	Database	CARDBOX	178.00	Discs	360K	
*****	Disc drive	incl	Spreadsheet	MULTIPLAN	210.00	Clock	4.7MHz	DISADVANTAGES: Software very expensive
SYSTEM	Printer	539.00	Accounts	GENERAL	403.00	Word-size	pseudo	Monitor only 80 X 25 lines
******	Stationery	50.00		ACCOUNTING			16 bits	
ALL-IN COST								
3589.00	HARDWARE COST	2622.00	SOFTWARE COST		967.00			

WREN	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: Very fast
****	Processor	1150.00	Word-processor	PERF WRITER	inc	Memory	64K	Built-in VIEWDATA modem
	Monitor	incl	Database	PERF FILER	inc	Discs	380K	
	Disc drive	incl	Spreadsheet	PERF CALC	inc	Clock	6MHz	DISADVANTAGES: Only 5 function keys
	Printer	250.00	Accounts	SAGE	431.00	Word-size	8 bits	7" screen with only 80 X 24 lines
	Stationery	50.00						Not IBM compatible
ALL-IN COST								
1881.00	HARDWARE COST	1450.00	SOFTWARE COST		431.00			

ACORN	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES:
*****	Processor	** ? **	Word-processor	VIEW	incl	Memory	32K	Wide range of low-cost software & add-ons
PERSONAL	Monitor	incl	Database	** ? **	** ? **	Discs	640K	
********	Disc drive	incl	Spreadsheet	VIEWSHEET	incl	Clock	2MHz	DISADVANTAGES: Not IBM compatible
ASSISTANT	Printer	** ? **	Accounts	** ? **	** ? **	Word size	8 bits	Cannot run MS-DOS programmes
*********	Stationery	** ? **						Small memory makes it slow
ALL-IN COST								
** ? **	HARDWARE COST	** ? **	SOFTWARE COST	** ? **				

* Act as a terminal to a mainframe.
* Link with other micros, or with peripherals such as modems, printers or hard discs, in an economical network that allows maximum usage to be squeezed out of each expensive piece of hardware.
* Multi-task: do two or more things at the same time, perhaps via different terminals, without significant delays. For example, interrupt the monthly stock update to prepare the debtors' statements while, at the same time, printing out the next press release.
— For such tasks memories of at least 128 and probably 256 or 512Kb are needed.

SOME IMPORTANT QUESTIONS

Many readers will immediately identify their business with one of these categories, others may have special needs. A few fundamental questions to ask, before actually considering the different systems available are:

1. How many programs will you use regularly and how long are they?
2. How many files will each have and how large will they be? On this answer depends your choice of disc storage. A single, 100Kb, single-sided floppy disc drive for keeping the cash book for your milk round, or a "hard" disc (Winchester) — now at prices that make them attractive even for the "BUILDER" scale of business. The kind of calculation needed is shown in Fig 1.
3. How complex are the tasks you do? The milkman may do his stock control (of probably no more than twenty separate products) in about 10K but the CORNER SHOP (small grocer or newsagent say) may stock more than a thousand different items. Use of a computer (with a bar code reader), to produce a daily or twice-a-week order list from the Cash and Carry may save enormously on stock-holding costs. This is just achievable with

a Z80 second processor and 64Kb of memory but would run faster with 128 or 256K.
4. Does it matter if it runs fast? At what do you value your own time? £2 per hour for garden clearing in North Wales or £100 per hour for neuro-surgery in Harley Street? Socially unjust it may be, but it decides if you can afford hundreds or even thousands of pounds on bigger memories, faster discs and more sophisticated programs that will do the same tasks quicker.
5. Will your business — and your computer system — need to grow? If your business grows
— your files will get bigger
— your bank account will have more transactions
— your mailing list will become longer
— you will become busier and more anxious to save time
— and so on
6. Today you may only want to sort out your book-keeping: what about tomorrow? If you are a gardener, would computer design stimulate your clients to buy more ambitious garden layout? If you are a fourth-former with a morning paper round, would a routing analysis give you ten minutes longer in bed each morning and less wear and tear on bicycle tyres? If you run a factory, would sophisticated control of heating and lighting systems cut the fuel bills?
7. How many potential users of your system? At the moment it may be just you groaning over the books on the sittingroom table of an evening, but in future?
— Sofware-controlled dialling for your telephonist?
— Modems and telephone link for your accountant?
— A separate terminal for your secretary, so she does not interrupt that vital report, needed on your most important client's desk tomorrow morning, just becaue you have not finished that elegant financial model of his project?
— An extra terminal in the workshop, so you can wipe your hands on an oily rag and deal with enquiries over the 'phone (at the callers expense!) instead of saying "Can I ring you back in half an hour?" (at your expense, and you'll probably have to dial three times before you get him!)?
8. Finally, are there any essential special features:
— access to VIEWDATA or other databases for up-to-date rates of exchange
— telephone links with your partner who also works from home half a mile away
— portability so you can produce the despatch notes at work during the day and send off the invoices from home in the evening (or even cure insomnia with heavy doses of machine code)
— voice recognition, because you never manage more than five words per minute on the keyboard.

FEATURES YOU CAN MEASURE — AND SOME YOU CAN'T

Answered all those? Now you begin to look at a few computers and find they all look the same! Salesmen assure you each is the best, most advanced, most powerful! How do you tell which one to buy? Fortunately some features can actually be measured, to give direct comparison between one micro and another. For example:

Memory: The more there is, the longer and more complicated the programs you can use and the quicker they run, not needing to be repeatedly swapped on and off disc.

Disc capacity: The bigger this is, the bigger and more files you can hold without constant "disc shuffling".

Clock speed: The faster the clock (the central processor's heartbeat, measured in MHz — millions of cycles per second or "Mega-Hertz") the quicker each operation is performed. An 8MHz computer will run nearly twice as fast as a 4.7MHz machine.

Word size: How big a chunk of data can be put into memory storage at one go: a computer that handles "words" of 32 bits will run four times as fast as one that uses eight bits. Beware however, some machines (the IBM PC, the Apricot and the QL for example) have a 16 bit processor that handles data over a "narrower" eight bit channel or "bus". Rather like going to the cup final, superb facilities to handle huge numbers of people, spoiled by hours in traffic jams getting there and away. These are described as "pseudo 16 bit" and will be only a little faster than eight bit processors, not nearly as fast as real 16 bit machines.

Price: There are so many excellent business micros around, this will be the tie-breaker.

Some features just cannot be quantified, you have to decide what they are worth. For example:
— Keyboard quality. Is it worth paying for "sculptured" keys on the IBM PC? Is the lack of a numeric key-pad on the BBC a serious disadvantage.
— Monitor quality. Do you need colour? If so, is "high resolution" (sharper picture) important? For most business applications a low intensity, green screen is most restful yet Acorn's new ABC100 will apparently offer either colour or white on black.
— Special features (or gimmicks? — you must decide the difference). There are a wide variety available
* desk-top "mouse"
* touch-sensitive screen
* voice recognition
* liquid crystal display of definable keys
* flat screen

THE UP-GRADE PATH

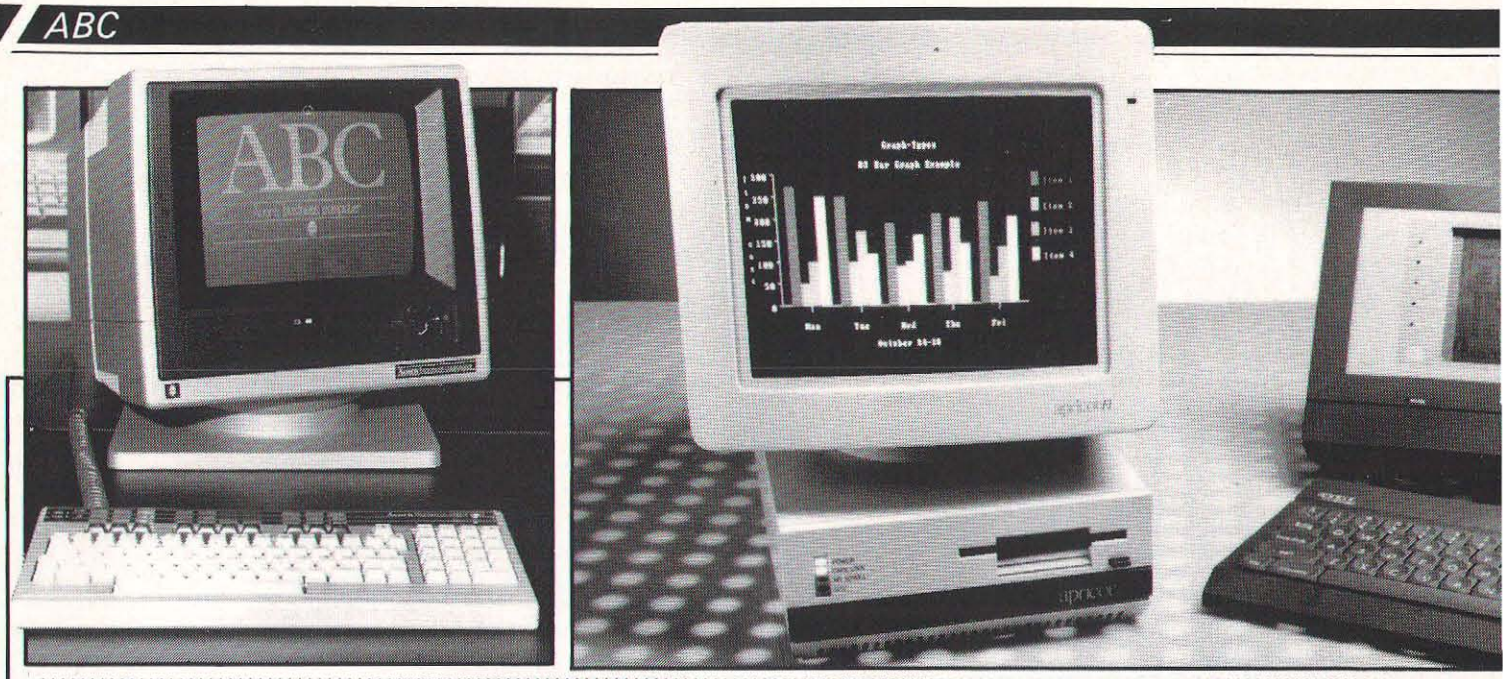
This means computerising your business softly, softly — buying something modest and basic to start with (possibly just a home micro) and adding not only software but extra hardware as your needs and resources grow. The advantages are:
— Better cash flow. You defer some of the expenditure for one or even two years, and the biggest expenses — such as a hard disc — come at the end.
— Better decision making. Some decisions are difficult and expensive, for example:
* Can I justify colour printing for clients' reports, mailshots or design sketches?
* Shall I go for CP/M or MSDOS operating system? Do I need IBM compatibility?
* Give the bookkeeper and storekeeper a stand-alone micro each or network them along with mine?
* Which accounting suite: Pulsar, Pegasus or Sage, or can I still get by with Gemini if I use a DataGem database?

Those who follow the upgrade path do not tackle these until they are more experienced at computing and also understand, far better, how their particular business relates to the computer systems available.
— Spread workload. The man or woman hours you will put into computerising your business may be worth much more than the actual capital cost. To put a few hundred or even thousand customers on a database, especially if you add contact names, regional codes, credit limits and the rest, as well as mere names, addresses and 'phone numbers, can take weeks if not months of data input time. (Most of it is spent gathering the information that formerly was spread around a dozen different address books, diaries, files and 'phone directories.) If you try to do this at the same time as computerising the books, the stock control and the forward planning something will have to give!
— Available technology. The "state of the art" of business computing is changing as rapidly as costs are decreasing. It makes sense to take decisions and incur costs as late as possible, but not so late as to miss real improvements in business profitability and management control.

CONCLUSION

The tables show that the BBC, with various enhancements, is a surprisingly serious contender for professional business use

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BUILDER

BBC WITH	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE	CAPACITY	ADVANTAGES: 15 user definable keys
********	Processor with Z80	869.00	Word-processor	MEMO-PLAN	incl	Memory	64K	Wide range of low-cost software & add-ons
ACORN Z 80	Monitor	100.00	Database	FILE-PLAN	incl	Discs	800K	
**********	4X200K Disc drive	400.00	Spreadsheet	CALC-PLAN	incl	Clock	4MHz	DISADVANTAGES: No separate numeric key-pad
	Printer	250.00	Accounts	ACCOUNTANT	incl	Word-size	8 bits	Cannot run MS-DOS programmes
	Stationery	80.00						Small memory makes it slow
ALL-IN COST								Not IBM compatible
1699.00	HARDWARE COST	1,699.00	SOFTWARE COST		0			

BBC WITH	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: IBM compatible
********	Processor	399.00	Word-processor	QUILL	incl	Memory	256K	Can run CP/M or PC-DOS programmes
GRADUATE	Monitor	100.00	Database	ARCHIVE	incl	Discs	720K	Very wide range of software
********	Graduate G800/2	1,149.00	Spreadsheet	ABACUS	incl	Clock	4.7MHz	Runs concurrent programmes
	Printer	250.00	Accounts	GENERAL	403.00	Word size	pseudo	
	Stationery	80.00		ACCOUNTING			16 bits	DISADVANTAGES: No free software
ALL-IN COST								Software very expensive
2381.00	HARDWARE COST	1,978.00	SOFTWARE COST		403.00			Screen only 80 x 25 lines

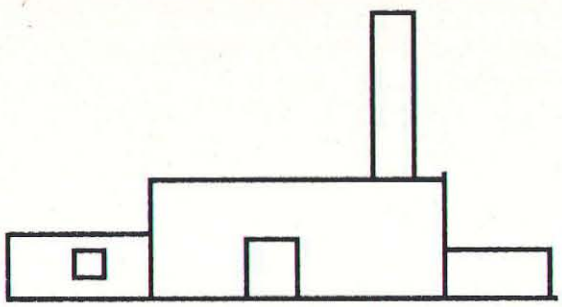
APRICOT F1	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: semi-portable: mouse, voice
**********	Processor	1,144.00	Word-processor	SUPERWRITER	incl	Memory	256K	recognition. Monitor 138 39 lines
	Monitor	287.00	Database	****		Discs	720K	LCD of 6 user-definable keys
	Disc drive	incl	Spreadsheet	SUPERCALC	incl	Clock	5MHz	Wide range of software
	Printer	250.00	Accounts	****		Word-size	pseudo	DISADVANTAGES: Not IBM compatible
	Stationery	120.00					16 bits	Purchased software expensive
ALL-IN COST								
1801.00	HARDWARE COST	1,801.00	SOFTWARE COST		0			

IBM PC	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: Excellent keyboard
******	Processor	2,375.00	Word-processor	EASYWRITER	176.00	Memory	64K	Can run CP/M or PC-DOS programmes
	Monitor	214.00	Database	CARDBOX	178.00	Discs	720k	Very wide range of software
	Disc drive		Spreadsheet	MULTIPLAN	210.00	Clock	4.7MHz	DISADVANTAGES: No free software
	Printer	539.00	Accounts	GENERAL	403.00	Word size	pseudo	Software very expensive
	Stationery	80.00		ACCOUNTING			16 bits	Monitor only 80 x 25 lines
ALL-IN COST								
4175.00	HARDWARE COST	3,208.00	SOFTWARE COST		967.00			

FERRANTI	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: IBM compatible but faster!
********	Processor	1,499.00	Word-processor	PERF WRITER	inc	Memory	128K	Can run CP/M or PC-DOS programmes
ADVANCE	Monitor	89.95	Database	PERF FILER	inc	Discs	720k	Very wide range of software
*******	Disc drive	incl	Spreadsheet	PERF CALC	inc	Clock		DISADVANTAGES:
	Printer	345.00	Accounts	GENERAL	403.00	Word size	16 bits	Software very expensive
	Stationery	80.00		ACCOUNTING				
ALL-IN COST								
2416.95	HARDWARE COST	2,013.95	SOFTWARE COST		403.00			

ACORN	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES:
ABC 100	Processor	** ? **	Word-processor	** ? **	** ? **	Memory	64K	Wide range of low-cost software & add-ons
	Monitor	incl	Database	** ? **	** ? **	Discs	1280K	
	Disc drive	incl	Spreadsheet	** ? **	** ? **	Clock	4MHz	DISADVANTAGES: Not IBM compatible
	Printer	** ? **	Accounts	** ? **	** ? **	Word size	8 bits	
	Stationery	** ? **						
ALL-IN COST								
** ? **	HARDWARE COST	** ? **	SOFTWARE COST		** ? **			

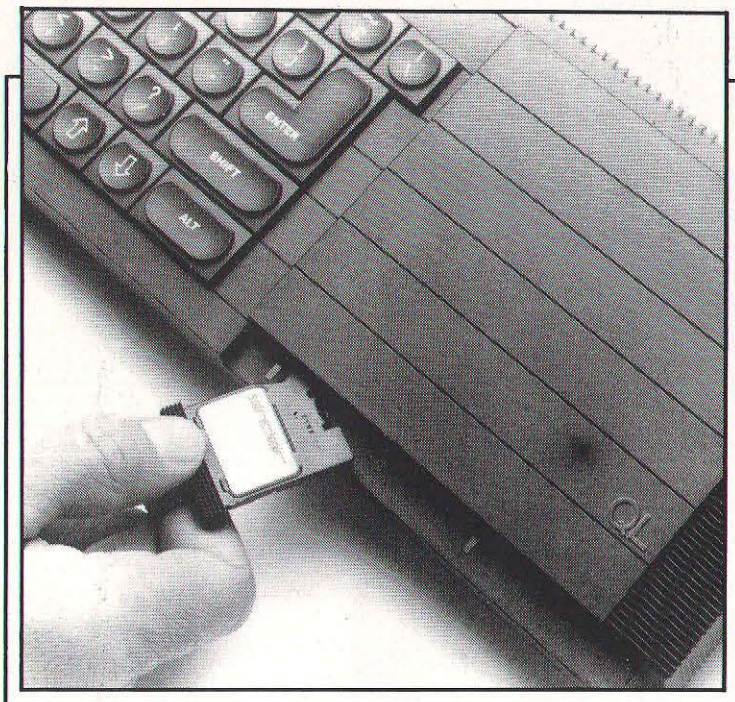
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FACTORY

BBC WITH	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE	CAPACITY	ADVANTAGES: 15 user definable keys
********	Processor	470.00	Word-processor	PERF WRITER	incl	Memory	64K	Wide range of low-cost software & add-ons
TORCH	Monitor	100.00	Database	PERF FILER	incl	Discs	20mB	
*****	Unicorn hard disc	3329.00	Spreadsheet	PERF CALC	incl	Clock	5MHz	DISADVANTAGES: No separate numeric key-pad
HDP240	Printer	400.00	Accounts	SAGE ACCTS	914.00	Word-size	8 bits	Cannot run MS-DOS programmes
******	Stationery	50.00	Payroll	SAGE PAYRL	incl			Hardware in several separate units
ALL-IN COST								
5263.00	HARDWARE COST	4349.00	SOFTWARE COST		914.00			
TOP OF THE RANGE MODEL								
**********								
THE UNICORN	Memory expansion	575.00	Multi-tasking	UNIX	460.00	Memory	288K	ENHANCEMENTS: Can run MS-DOS
**********						Discs	20mB	Memory expansions to 1mB available
ALL-IN COST						Clock	10MHz	UNIX allows easy data transfer between
6298.00		4924.00			1374.00	Word size	pseudo	programmes, powerful networking, etc
APRICOT Xi	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: Runs Concurrent DOS and CP/M
**********	Processor	3214.00	Word-processor	SUPERWRITER	incl	Memory	256K	All hardware except printer in one console
	Monitor	287.00	Database	SUPERPLAN		Discs	10mB	LCD of 6 user-definable keys
	Hard disc unit	incl	Spreadsheet	SUPERCALC	incl	Clock	4.7MHz	4 other function keys
	Printer	400.00	Accounts	PULSAR	780.00	Word-size	pseudo	Mouse, voice recognition available
	Stationery	90.00	Payroll	PULSAR	195.00		16 bits	
ALL-IN COST								
4966.00	HARDWARE COST	3991.00	SOFTWARE COST		975.00			
TOP OF THE RANGE MODEL								
**********								
	Memory expansion	795.00	Multi-tasking		30.00	Memory	768K	
	Colour screen	454.00				Discs	20mB	
ALL-IN COST						Clock	4.7MHz	
6245.00		5240.00			1005.00	Word size	pseudo	
IBM PC XT	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES: Excellent keyboard
*********	Processor	4590.00	Word-processor	EASYWRITER	176.00	Memory	128K	Can run concurrent programmes
	Monitor	214.00	Database	CARDBOX	178.00	Discs	10mB	Very wide range of software
	Disc drive	incl	Spreadsheet	MULTIPLAN	210.00	Clock	4.7MHz	DISADVANTAGES: No free software
	Printer	539.00	Accounts	PEACHTREE	1683.00	Word size	pseudo	Software very expensive
	Stationery	80.00					16 bit	Monitor only 80 X 25 lines
ALL-IN COST								
7670.00	HARDWARE COST	5423.00	SOFTWARE COST		2247.00			
TOP OF THE RANGE MODEL								
**********								
EXPANDED XT	Memory expansion	616.00	Multi-tasking	CP/M 86	229.00	Memory	640K	Will not run UNIX
**********	Colour screen	568.00				Discs	20mB	
ALL-IN COST	Disc expansion	1978.00				Clock	4.7MHz	Extensive range of further upgrades to
11061.00	HARDWARE COST	8585.00	SOFTWARE COST		2476.00	Word size	pseudo	PC AT (runs UNIX) and other IBM machines
							16 bit	
ACORN	HARDWARE	PRICE	SOFTWARE		PRICE	FEATURE		ADVANTAGES:
*****	Processor	** ? **	Word-processor	** ? **	** ? **	Memory	64K	Wide range of low-cost software & add-ons
ABC 110	Monitor	incl	Database	** ? **	** ? **	Discs	10mB	
*******	Disc drive	incl	Spreadsheet	** ? **	** ? **	Clock	4MHz	DISADVANTAGES: Not IBM compatible
	Printer	** ? **	Accounts	** ? **	** ? **	Word size	8 bits	Will not run MS-DOS
	Stationery	** ? **						
ALL-IN COST								
** ? **	HARDWARE COST	** ? **	SOFTWARE COST	** ? **	** ? **			
TOP OF THE RANGE MODEL								
**********								
ABC 310	Memory expansion	** ? **	Multi-tasking	** ? **	** ? **	Memory	1MB	ENHANCEMENTS: Will run concurrent MS-DOS
*******	Colour screen	** ? **		Unix?	** ? **	Discs	10mB	
ALL-IN COST						Clock	8MHz	
?	HARDWARE COST	** ? **	SOFTWARE COST		** ? **	Word size	16 bit	

CONTINUED OVER



DISC CAPACITY OF TYPICAL MEDIUM FIRM

APPLICATIONS PROGRAMMES	Bytes 1000
Database	130
Spreadsheet	300
Wordprocessor	200
Spelling checker + dictionary	70
Accounts	300
Payroll	160
Inventory control	200
Graphs	160
Utilities	300
TOTAL APPLICATIONS	1820
FILES	
Database of 1000 members	400
Accounts —	500 transactions
— Current year	350
— Previous year	350
Inventory (1000 items)	150
Payroll (50 employees)	110
Miscellaneous text files	1000
Miscellaneous spreadsheets	400
TOTAL FILES	2760
TOTAL DISC CAPACITY NEEDED	4580

This clearly justifies a 5 (or even 10) megabyte hard disc unit.

Figure 1.

throughout the whole microcomputer range. It has some powerful assets:
— low-cost of hardware and software (thanks to its share of the huge home market)
— great flexibility — the range of interfaces and connections for peripheral equipment is almost unique
— an excellent BASIC language (also partly responsible for the low cost of software)
— its superb screen display
The screen has been praised for games and graphics nonsense, yet completely overlooked (even by Acorn's publicity agents) in terms of business use. The standard IBM display of 80 columns by 25 lines is fine for full screen texts or data displays but cripplingly restrictive for split screen editing and even worse when one uses "windows". As these are the trend of modern, integrated, concurrent software, this substantial asset should be fully exploited.

There are weaknesses, principally the lack of a numeric keypad and the pitifully small memory. Acorn's new ABC range tackles the first but does not help existing BBC owners. The Graduate and Z80 second processors largely overcome the second.

The top of the range Graduate G800/2, at £1149 is not cheap and its key feature of IBM compatability means software is also expensive. GENERAL ACCOUNTING, the cheapest serious integrated accounting program recommended by IBM, costs over £400 and PEACHTREE accounting is even dearer. Nonetheless, with its 256Kb memory, G800/2 fills the one serious gap in the range of BBC business upgrades, at an all-in cost competitive with other IBM look-alikes. TORCH have promised one for review in this column shortly.

Z80 second processors from TORCH and ACORN (with others already advertised) do not wholly overcome the memory shortage. Users of serious software (any suite that uses half a dozen programs, some of them over 20Kb in length) fret at constantly waiting while the processor swaps data to and from the discs. The problem diminishes for those who use Winchester disc drives, which operate faster, but this is an expensive solution. It should not be too difficult to produce a 64K and a 128K memory board to fit BBC Z80s and the ABC100 and 110.

ACORN and TORCH, now united and committed to the business scene, have a chance to dominate business computing in Britain just as ACORN dominates educational computing. Whether they do so during the next five years depends not only on exotic developments of voice recognition, touch-screens or superpowerful integrated circuits, although those will become important thereafter. In the immediate terms the completion of the upgrade path that starts with the BBC home computer is vital.

To summarise, buying and later upgrading a BBC Micro can be regarded as a realistic and cost-effective strategy for any small or medium sized business.

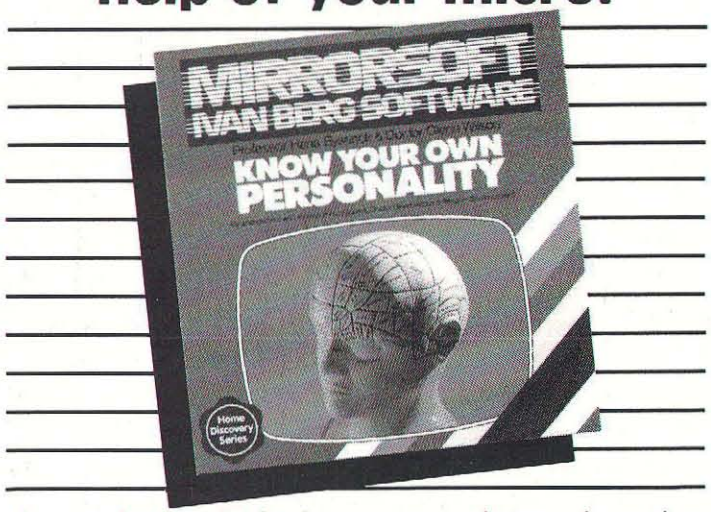
NOTES TO THE TABLES

1) Processor prices include disc interface
2) Software includes ROM "firmware"
3) All prices are VAT inclusive
4) Software listed is the cheapest available for the machine and task defined
5) Stationery includes printer paper and discs
6) While every effort has been made to ensure accuracy, readers are recommended to confirm prices and specifications locally before buying

Personality Tester

Jonathan Evans

Get an insight into your own character with the help of your micro.



Software for home users of micros falls into three main categories: games, educational software and business type programs (wordprocessors, database programs etc). The last type are probably of use only to a minority of owners and generally require expensive peripherals such as disc drives and printers.

Computers, especially the BBC, may often be bought with educational applications for the children in mind, but one suspects that in many households they end up mainly as games machines.

Mirrorsoft, with their Home Discovery Series (available on tape at £9.95 and disc at £12.95), are trying to provide a different type of software: definitely not games, "serious" in terms of home use but not claiming to meet business standards (or prices).

The program reviewed here, Know Your Own Personality, certainly shows high standards of program and documentation design. It is a revival in electronic form of Professor Hans Eysenck's highly successful Penguin book of many years standing. Eysenck, a prolific publisher of scientific papers and books, is probably one of the best known psychologists to the lay public due to his regular excursions into popular writing.

The program administers and scores three personality tests concerned with Extraversion/Introversion, Emotional Stability and Toughmindedness. Each test involves the user in providing yes, no or don't know answers to 210 questions. Owing to memory limitations each loads in three sections of 70 questions. Neat Mode 7 screens are used to present the questions, though the answers keyed in are not displayed and there is no chance to correct or edit them. This is probably a good thing, on balance, since the necessary procedures would make an already long test pretty tedious.

After completing a test the data is instantly analysed and displayed in terms of a number of personality "traits" related to the main dimension. For the extraversion test these include activity, sociability, risk taking and so on. Your results are shown graphically as deviations from the population average, with brief comments on each trait score if it deviates significantly from the average. There is an option to dump these displays to a printer, if you have one, and to save the data you have entered to tape/disc.

As a professional psychologist myself, I am probably not the best person to judge the comprehensibility of the documentation on personality testing by Eysenck and Glenn Wilson. However, it seemed well written to me and to strike a fair balance between the dangers of simplicity on the one hand and blinding with science on the other.

Of course few issues are uncontroversial in an academic psychology and there are certainly critics of the approach to personality taken by these authors. However, the user is warned in the program and documentation not to take the whole exercise too seriously.

In taking the tests, the relevance of some items will appear obvious, but others much less so. The intuitive relevance or "face validity" of the items is actually not very important because of the way in which such tests are constructed.

The field of psychology concerned with mental testing, called psychometrics, has a long history and well established methodologies. The accuracy of such tests is divided between "reliability" which is the stability of the test, or the consistency with which individuals would receive similar scores if tested more than once, and "validity" which is the degree to which the test measures what it claims to measure.

Constructing reliable and valid questionnaires is a very time consuming and expensive business, the details of which I do not have space to describe here. The only reason that the micro owner can receive this type of software so cheaply is that it is a "spin-off" from research already conducted for other purposes.

Psychometric tests which reliably discriminate abilities and personality traits between individuals have a number of serious applications, for example in selecting people for different occupations or choosing appropriate educational programmes or psychotherapies.

At present the advent of cheap microcomputers is causing a methodological revolution in psychometric testing. Automating questionnaires and revalidating them under computer controlled presentation is receiving massive attention.

The classical dilemma has been that tests conducted by psychologists personally are more reliable but pencil and paper tests much cheaper and more convenient to administer. The use of micros seems to resolve the problem since the technique can cheaply improve on the reliability of the former questionnaire methods.

Also the computer may take additional measurements, such as decision time, which would not have been possible previously in the absence of a professional tester. Many, however, feel that there is a disturbing implication in all this. If your child develops serious behavioural problems do you want him or her to be seen by the educational psychologist or referred to the school's computer?

Returning to the program, I suspect it may be popular owing to people's fascination with trying to understand themselves. There is, however, an intrinsic problem with this type of program. What do you do with it once you've done it once?

Some suggestions are made in the documentation, eg compare your personality with that of your boyfriend /girlfriend, spouse etc. Try filling it in as if you were him or her and compare it with what they do themselves. What happens if you find out that you are hopelessly incompatible, I wonder?

Does this program perform the opposition function to Eysenck's Dating Game and split couples asunder? Well, if you take the program that seriously there must be something strange about you to start with!

Random Access

Sell your BBC and buy a QL? What's the world coming to? Dave Carlos ticks off an errant reader.

Alistair Thorn of Doncaster is having difficulty choosing a Disc Interface and has even gone as far as to threaten to sell his BBC and buy a QL.

Far from solving his problems, I have the feeling that buying a QL might just increase them, so my first piece of advice is to forget that idea.

Alistair is concerned that a number of the double density interfaces can't run the newer Acornsoft games such as Elite and he is right to be worried.

The reason for the problem is that the new protected disc software, and Acorn aren't the only ones to do it this way, uses features of the 8271 floppy disc controller chip that aren't easily accessible from the normal DFS commands. Without giving too much away, they use certain commands within the 8271 to format the disc in such a way that errors are caused when the disc is read by the usual load and save commands from the DFS.

The result of this is that the discs cannot be copied easily and at the same time they don't run on the disc interfaces that don't incorporate the 8271 chip itself.

Alistair comments upon the scarcity of this chip and the number of local dealers that never get any at all. The chips are scarce, it is rumoured that the last production run was in 1979!, and therefore I would advise anyone looking for a DFS including this chip to make sure that the dealer who is selling them the drive will also supply a 8271 based disc interface at the same time.

I have heard of customers buying a drive in the hope that they will get an interface later and after storing a drive for a number of weeks still not having the interface needed to use it.

There is help on the way however and a couple of manufacturers are now claiming that their non-8271 based interface is fully Acornsoft compatible. I have heard of two such claims so far, Opus announced that their new double density DFS interface was developed with Acorn's experts and is fully compatible. The other claim is made by United Disc Memories (UDM) who told me that their latest interface will "run anything, well almost!". They certainly claim that it will cope with Elite so it might be just what Alistair needs. I cannot assess the claims yet as I haven't been able to test the interfaces.

Just a quick mention for the latest interface to have been through my machine, the DDFS from Solidisk. This has to be one of the cheapest disc interfaces with a cost of just £39.95. It is based around the WD1770 floppy disc controller and is a double density system allowing either the usual 10 sectors per track or the double density format of 16 sectors per track. The whole interface is very easy to use and even easier to fit than the Acorn interface. There are only four components and two shorting plugs to be installed, they are all just plugged in and there is no track cutting or soldering required at all.

The interface is very intelligent, ie it knows which density of disc is inserted and changing files from one density to the other is very simple indeed, you just use *COPY and the interface does the rest. The worst features are its rather rushed looking manual and the lack of Acornsoft compatibility. If neither of these are of vital importance to you then you should find this interface a very good buy indeed.

A&B is distributed even further North than Doncaster I find, as the next query is from Peter Brown in Caithness. Peter wants a full explanation of those rather cryptic numbers that the DFS supplies with its error messages.

I find it quite strange that after writing such a friendly and accessible error reporting system for the BBC, the Acornsoft programmers should give such unfriendly messages in the DFS. It could be something to do with the amount of space available I suppose but never fear, here is a list that you should keep besides your drive and a few comments where appropriate.

Code Hex/Dex		Error	Comment
08	8	Clock error	Might be due to a bad disc or a drive fault. Reformat after removing any valuable files.
0A	10	Late DMA	Very unusual error and generally caused by a sick computer.
0C	12	ID CRC error	As error 8 above. (Very rare.)
0E	14	Data CRC error	As error 8 above. (Not so rare!)
10	16	Drive not ready	Disc stopped rotating during a file transfer, might be inserted incorrectly.
12	18	Write protect	This error is changed by the DFS into a "friendly message" and is only included here for the sake of completeness.
14	20	Track 0 not found	The controller cannot find track zero. This may be due to a faulty disc, a badly aligned drive or an unformatted disc. The latter is most likely to cause error &18 though.
16	22	Write fault	Rare but usually due to a faulty computer.
18	24	Sector not found	Might be an unformatted disc or that a disc is protected or has been corrupted in some way. Reformat, if there is no valuable information on the disc.

That's the list, I have never seen some of them and never want to, thank you very much. I cannot claim that it is fully accurate therefore.

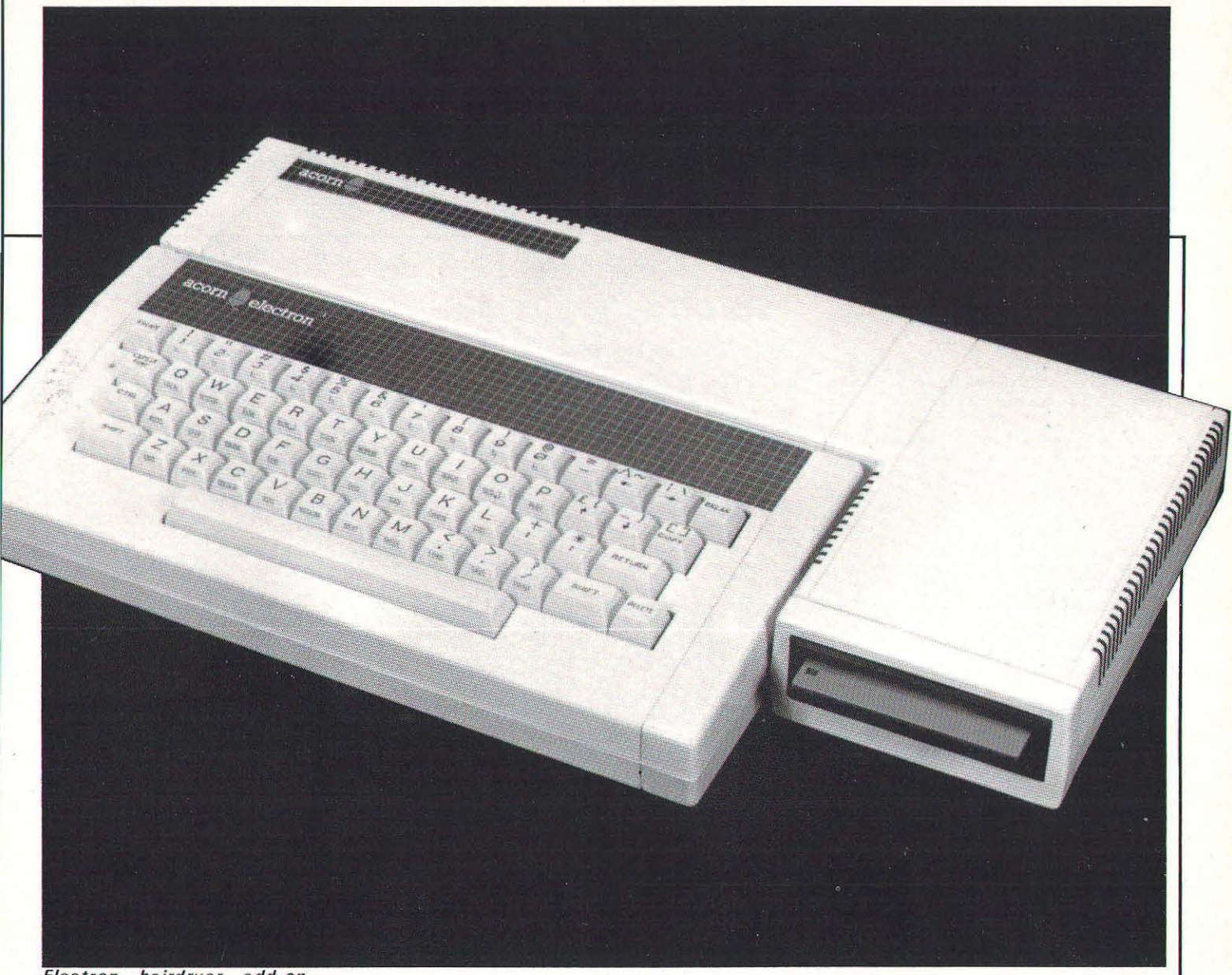
The best that I can wish any of you is that you never have the need to read this list again. I would suggest that you keep a copy though as you never know what is round the next corner or, in this case, waiting for the next disc access!

Finally, Waseem from Stechford in Birmingham sent me a letter containing enough questions to fill this column until next Christmas. Whilst I cannot answer all of them, here are a few comments and pointers.

The difference between a DFS and a disc interface is one of his queries and I have to admit that I sometimes use the terms in a rather sloppy manner which could lead to confusion. A disc interface is all the chips that are needed in order for a machine to be able to store data and programs on a disc in a disc drive. In the Acorn DFS there are a total of 11 chips in an interface and one of these is the DFS chip itself.

To call the DFS a chip can be confusing in itself, for the DFS (ie Disc Filing System) is really a program. In the case of the BBC machine the program is supplied on a chip (probably an EPROM) and fits into one of the sideways ROM sockets just under the keyboard.

This piece of firmware con-



Electron hairdryer add-on

trols the functioning of the disc drive and allows us to use friendly commands such as *CAT instead of having to resort to machine code in order to be able to use the drive. It takes care of all the "housekeeping" like remembering where all the programs are on the disc and where to put the next one.

You cannot use disc drives without a disc interface and you cannot use a DFS without an interface either. The type of DFS that you use with a particular interface can be changed however.

For example there are several DFS programs that work with the standard disc interface, including the 8271 chip that figures so prominently above. You might choose to use the Acorn DFS 9.90, Acorn DNFS 1.2,ANCOM DFS, MRM E00 DFS or Watford DFS to name just a few of the possible alternatives. Remember, you cannot use the interface without a DFS nor a DFS without the interface.

Waseem also asks about the differences between the differing makes of drive and if it is true that the cheaper types of drive are more prone to error. I cannot say that I have used all types of drive but I have used a number now and I find that most drives give very few errors indeed. In fact if pushed, I would have to admit that the drives that gave me the most trouble were the most expensive that I have owned, they were the only ones on sale for the BBC at the time.

What is essential is that you know the access times for the drive that you propose to use and, if these are different from the default timings, that you should make the links at the front of the keyboard. In case you are not aware of these links, they can accommodate a bank of switches, in DIL format, and can be switched on or off (made/unmade) at will, if such a switch bank is soldered to the keyboard. The links are numbers from 1 to 8, WEST to EAST, and the ones relevant to Drive type are links 3 and 4. The settings are:

Olivetti, Tandy and TEAC	Both unmade
MPI or similar	3 unmade, 4 made
Tandon, Shugart, Canon and other 6 msec access drives	3 made, 4 unmade
Tandon, Mitsubishi and other 4 msec access drives	3 made, 4 made

That should just about cover the major types and if in doubt you should ask the supplier for the timings. You need to select the combination that is correct for your drives and the error rate should become so insignificant that you don't even notice which drives you are using.

That's it for this month but keep the letters rolling in. Please remember that I cannot answer any directly, so don't enclose an envelope for reply or ring up (I don't work in the office either!).

The Address is:

Dave Carlos (Random Access)
A&B Computing,
1 Golden Square,
London,
W1R 3AB

See you next month! ■

Advanced Graphics

Bruce Smith

An exploration of the Beeb's graphics capabilities from machine code.

This month's column has been adapted from Bruce Smith's excellent book The BBC Micro Machine Code Portfolio, price £7.95.

The following machine code assembler routines are implemented as PROCedures, with each having its own range of line numbers. The procedure contains all the necessary coding to make the routine a stand-alone one.

Because a procedure must be called from a program, each program contains several lines of BASIC to call first the PROC to assemble the machine code it contains and then demonstrate the type of application possible. This serves two functions; first, it assures you that you have entered the program correctly and also shows you how it works! If you flick through a few of the programs you'll notice that the lines of the PROC are given high line numbers in steps of one while the assemble and test routines use low line numbers. This is quite deliberate as it keeps the two parts of the program clearly separated.

To build up a library of these programs to disc or tape, the PROCedure can be saved to tape. As the low line numbers are only, in effect, test routines these can be deleted so that only the procedure remains; and it is this that should be saved.

I prefer to save my PROCedures as ASCII files rather than programs as this allows them to be added easily to other programs. The *SPOOL command is used to perform this. Choosing a suitable filename, the syntax is simply:

***SPOOL NAME**

If you are using the cassette filing system then you'll need to start the cassette running. If you are using discs then these will already be whirling around. So, now simply LIST the program. As the listing appears onto the screen it will also be written to the current filing system. When the program has finished listing enter:

***SPOOL**

once again to complete the transfer from memory to filing medium. You will probably have noticed that the filename used in the *SPOOL command was not enclosed within the quotes normally associated with a SAVE. This is acceptable as the MOS does not expect them — though using them will have no adverse effect.

Once all programs have been treated in this way they are ready to be used in a greater scheme of things! One point — when building up a large library of procedures it is very important to catalogue them, in a book, on another disk or tape, or on the front of each tape or disc. This catalogue should depict the program's name, line numbers and function as this will be invaluable when it comes to using them at a later date.

Once a program has been saved as a spooled file it can be loaded back into memory using the MOS-based *EXEC command. To load the previously spooled file you use:

***EXEC NAME**

Again, the quotes around the filename are not obligatory. When the operating system encounters the file it treats each line of it as though it had been typed in at the keyboard and as the return character at the end of the line is reached the line is entered into memory. This is the main reason for using unique line numbers within procedures, as it enables several procedures to be *EXECuted into memory without fear of overwriting any program lines already there.

LET'S DEMONSTRATE

Suppose a short graphics routine is required that will select a Mode 4 screen and draw a dotted line from the coordinate 200,200 to 900,600. First, the three desired files to perform MODE, MOVE and PLOT must be loaded in. Depending on the filenames you have chosen, this might take the form of executing the following commands one by one:

***EXEC mode**
***EXEC move**
***EXEC plot**

The resultant listing forms part of Program 1. Next, a BASIC primer needs to be written to call each PROC and pass the relevant information through the arguments of the procedural call. First, PROCmode:

20 PROCmode (4, &A00)

The PROCedure is called passing the mode number, 4, into the variable "action" and the assembly address, &A00, into "addr". Next, the graphics cursor must be moved. The problem here is that we do not really want to have to calculate the new value to be assigned to "addr" for the code assembly; instead we can simply use the program counter itself in the form of P%. Thus line 30 becomes

30 PROCmov (200, 200, P%)

The move coordinates are 200,200 and the PROCmove code is assembled from P%. Finally PROCplot can be treated in the same way to give

40 PROCplot (21,900,600,P%)

where 21 is the plot code for an absolute dotted line, 900,600 the final coordinates and P% the assembly address.

Now each PROCedure will assemble its code as a subroutine call. To implement the machine code, a short procedure must be written that will call each subroutine in turn, thus:

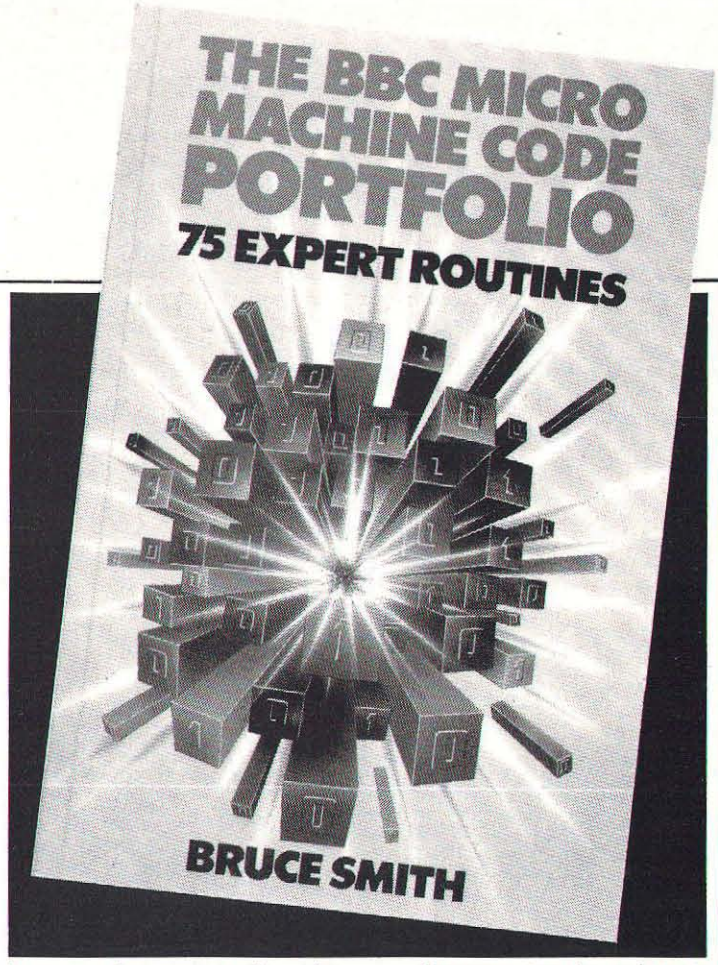
JSR mode / set up MODE
JSR move / move graphics cursor
JMP plot / draw line and return

Program 1 lists the final program and, by way of proof of the output, Figure 1 lists the assembler listing produced when RUN.

```
>RUN
0A00
0A00                .mode
0A00 A9 16          LDA #22
0A02 20 EE FF       JSR &FFEE
0A05 A9 04          LDA #action
0A07 20 EE FF       JSR &FFEE
0A0A 60             RTS
0A0B
0A0B                .move
0A0B A9 19          LDA #25
0A0D 20 EE FF       JSR &FFEE
0A10 A9 04          LDA #4
0A12 20 EE FF       JSR &FFEE
0A15 A9 C8          LDA #xpos MOD 256
0A17 20 EE FF       JSR &FFEE
0A1A A9 00          LDA #xpos DIV 256
0A1C 20 EE FF       JSR &FFEE
0A1F A9 C8          LDA #ypos MOD 256
0A21 20 EE FF       JSR &FFEE
0A24 A9 00          LDA #ypos DIV 256
0A26 20 EE FF       JSR &FFEE
0A29 60             RTS
0A2A
0A2A                .plot
0A2A A9 19          LDA #25
0A2C 20 EE FF       JSR &FFEE
0A2F A9 15          LDA #code
0A31 20 EE FF       JSR &FFEE
0A34 A9 84          LDA #xcord MOD 256
0A36 20 EE FF       JSR &FFEE
0A39 A9 03          LDA #xcord DIV 256
0A3B 20 EE FF       JSR &FFEE
0A3E A9 58          LDA #ycord MOD 256
0A40 20 EE FF       JSR &FFEE
0A43 A9 02          LDA #ycord DIV 256
0A45 20 EE FF       JSR &FFEE
0A48 60             RTS
0A49
0A49                .test
0A49 20 00 0A       JSR mode
0A4C 20 0B 0A       JSR move
0A4F 4C 2A 0A       JMP plot
```

Figure 1. Assember listing produced by program 1.

When using this modular-cum-structured assembly approach, the command is omitted then the default value of three will be assumed by the assembler. In the case of the above example this was not too much of a problem, but there are occasions when it will be! For example, if assembly is performed on a conditional basis then it may be desirable to suppress it altogether using OPT2 lest it corrupt some vital screen detail. Alternatively, a FOR...NEXT combination may be imperative to suppress errors during a first pass to assign forward branch labels. There is no simple way around this. A



universal solution would be to include a
FOR pass = 0 TO 2 STEP 2
line in all procedures. I prefer to add the OPT commands as required, but the choice is yours.

Now let's look at some of the graphics commands available from BASIC and put them into machine code.

JUST MODE ABOUT YOU

Program 2 performs a mode change in machine code. This is done by sending the VDU value 22 to the driver followed by the mode number which should be passed into the procedure via "action". The assembled code is very short — just 11 bytes including the RTS.

MOVING ON

The three drawing-orientated processes, MOVE, DRAW and PLOT, can be performed using a VDU25 sequence by passing bytes through OSWRCH. After issuing the VDU25 sequence, OSWRCH expects five more bytes to be passed through to it. The first of these determines exactly what function is to be performed, while the remaining four bytes provide the double-byte values of first the X and then the Y coordinates, low bytes first.

Program 3 lists a suitable MOVE procedure. The MOVE code is 4 (line 6186) while the X, Y coordinates are passed for immediate addressing through the variables "xpos" and "ypos". The demo uses the procedure to move the graphics cursor to the centre of the screen at 640,512 before plotting a point there (lines 20 to 50).

Program 4 uses the driver code 6 (line 6206) to execute the machine code equivalent of a DRAW. The positions passed into the procedure are taken to be the coordinates to draw to. The demo program draws a line diagonally across the Mode 4 screen from 0,0 to 1000,1000. Once again, immediate addressing is used in the program to obtain the X, Y coordinates which must therefore be passed into the procedure at assembly time.

A PLOT is performed using the driver code which is equivalent to the plot function required. Program 5 shows how the PLOT code is passed into the procedure through the variable "code". The demo uses code 85 to draw and fill a triangle in a Mode 4 screen. As you may now realise, the previous two programs were, in fact, simply using the plot codes for move and draw.

PAINTBOX

The use of colour is usually desirable for graphics and both COLOUR and GCOL can be readily performed. Program 6 can be used to redefine the text colour used by PRINT. It uses the VDU17 command with a second byte in the range 0 to 15 being passed to OSWRCH to define the colour. The number associated with each physical colour is detailed in Figure 2 and the chosen value should be passed to the procedure in the "print_colour" variable. The demo sets up printing in red on a Mode 2 screen.

Number	Colour
0	Black
1	Red
2	Green
3	Yellow
4	Blue
5	Magenta
6	Cyan
7	White
8	Flashing black-white
9	Flashing red-cyan
10	Flashing green-magenta
11	Flashing yellow-blue
12	Flashing blue-yellow
13	Flashing magenta-green
14	Flashing cyan-red
15	Flashing white-black

Figure 2.
The physical colours.

Program 7 shows how the background colour can be redefined using VDU17 again. Essentially the program is the same as its predecessor. To stipulate a background colour, however, the most significant bit of the colour byte must be set. In everyday terms, this simply means adding 128 to the colour value. After passing the background colour to the VDU driver (lines 6276 to 6277) the screen must be cleared. This is facilitated simply by printing the equivalent of a VDU12 (lines 6278 to 6279). The demo program initialises a red Mode 2 screen.

Performing GCOL is almost as easy, however. The GCOL statement requires two parameters. After issuing VDU18 first, the byte depicting the action required (i.e. AND, OR, EOR) should be passed to OSWRCH followed by the colour. These bytes are shown in Program 8 as "action" and "colour" and the associated demo program (lines 10 to 70) set up a flashing black and white diagonal line across the Mode 2 screen.

The graphics screen can be cleared from BASIC using the command CLG. In machine code this is simplicity itself and only requires the vdu driver to print the code 16 through OSWRCH. Program 9 demonstrates this.

Programming the palette is done as in BASIC using VDU19 in the form:
VDU 19, log,phy,0,0,0
where "log" and "phy" refer to the logical and physical colours respectively. Program 10 shows how this is translated into assembler. After the 19 is printed (lines 6314 and 6315) the logical and physical colour codes are passed to OSWRCH (lines 6316 to 6319) followed by the three padding zeros (lines 6320 to 6323) reserved for future expansion, whatever that is! Once again, the values passed into the procedure for "log" and "phy" are interpreted as immediate values by the assembler.

The lines 10 to 110 show how the procedure is used in this case to re-set the current screen background logical colour to each physical colour in turn.

READ IT WRITE!

Occasionally it is useful to be able to know the last two sets of coordinates visited by the graphics cursor, so Acorn have implemented an OSWORD call to enable this feat. The call code is

CONTINUED OVER

13 and as with all OSWORD calls an address held with the index registers points to a parameter block where in this case OSWORD deposits the required information. Figure 3 details the information contained in the block after the call and Program 11 the technique. Lines 10 to 140 demonstrate the call by first moving the graphics cursor to a few positions on the Mode 4 screen before calling the procedure and reading its eight-byte result from the parameter block which in this instant is in zero page.

XY+0	previous X coordinate LSB
XY+1	previous X coordinate MSB
XY+2	previous Y coordinate LSB
XY+3	previous Y coordinate MSB
XY+4	current X coordinate LSB
XY+5	current X coordinate MSB
XY+6	current Y coordinate LSB
XY+7	current Y coordinate MSB

Figure 3. OSWORD 13 parameter block for reading last two graphics coordinates.

The condition of any pixel on the screen can also be read using OSWORD with the accumulator holding nine — in effect, mimicking BASIC's POINT command (see Program 12). Before calling the operating system routine, the obligatory parameter block (detailed in Figure 4) must have some relevant details placed into it, namely the X, Y coordinates of the byte to be tested. Each coordinate uses two bytes of the parameter block and these are derived in lines 6345 to 6361 of the procedure. The procedure again assumes that the actual coordinates, and not an address containing them, are passed through the variable X and Y. Each byte is then stored in the relevant parameter block location. After sending the parameter block address into the index registers (lines 6362 to 6364) the OSWORD call is performed leaving the logical colour of the coordinate in the fifth block of the parameter block — or &FF if the point was off of the screen.

XY+0	X coordinate LSB
XY+1	X coordinate MSB
XY+2	Y coordinate LSB
XY+3	Y coordinate MSB
XY+4	Logical colour of point. &FF if point off screen.

Figure 4. OSWORD 9 parameter block to perform POINT.

The colour palette can itself be read using an OSWORD 11 as shown in Program 13. The logical colour to be read should be placed into the five-byte parameter block. After the call, the physical colour currently assigned to the logical colour is in the second byte of the parameter block. The remaining three parameter block bytes contain zero — yes, for future expansion! The BASIC demo uses the call to read the physical colour assigned to logical colour 1 on the Mode 4 screen, this having been defined prior to the call in line 30 as 3.

Program 14 performs the operation in the reverse direction by writing to the palette using OSWORD 12. The parameter block is identical to that in a read operation except that the physical colour to be written must also be placed into the parameter block. The procedure passes both logical and physical colours to the assembler through the variables L% and PY%. The demo resets the Mode 4 logical colour 0, the background colour, to physical colour yellow, thereby performing an instant change in background colour.

CO-ORDINATING SCREEN ADDRESSES

The final routine, Program 15, utilises the BASIC interpreter's *640 table at &C357 to convert an XY coordinate position on the screen (Modes 0, 1 and 2 only) into an absolute memory address. The table is a 32 byte by 2 byte affair which, unusually, is presented high byte first.

The program begins by clearing a few bytes of memory (lines 6505 to 6509) and setting vector to the start screen address. The MOD 8 value of the "yaxis" is then calculated along with the DIV8 value (lines 6510 to 6513). The actual value to be calculated is, in fact, Y DIV 8 *640. However, since the table values are two-byte the DIV is restricted to four (lines 6514 to 6516). The accumulator is transferred into the Y register to get the index into the table, and is subsequently incremented to get the second, low byte (lines 6516 to 6518).

The low byte is added to give Y axis MOD 8 (lines 6519 to 6522) and after extracting the high byte from the table this is added to give Y axis DIV 8 *640 (lines 6523 to 6527). Finally, the X axis value is multiplied by eight and any bits fall ing off are caught in "vector+3" (lines 6528 to 6533).

This is then added to the low byte of the screen address to give the final address (lines 6534 to 6539). By way of demonstration, &F is then poked into screen memory at this point; to see this the program will need to be run in MODE 2 (lines 6540 to 6542).

PROGRAM LISTING 1

```
 10 REM *** USING THE PORTFOLIO ***
 20 PROCmode (4,&A00)
 30 PROCmove (200,200,P%)
 40 PROCplot (21,900,600,P%)
 50 PROCassemble(P%)
 60 CALL test
 70 END
 80 :
100 DEF PROCassemble (addr)
110 P%=addr
120 [
130 .test
140             JSR mode
150             JSR move
160             JMP plot
170 ]
180 ENDPROC
200 :
6000 DEF PROCmode (action,addr)
6001 P%=addr
6002 [
6003 .mode
6004            LDA #22
6005            JSR &FFEE
6006            LDA #action
6007            JSR &FFEE
6008            RTS
6009 ]
6010 ENDPROC
6180 DEF PROCmove(xpos,ypos,addr)
6181 P%=addr
6182 [
6183 .move
```

PROGRAM LISTING 2

```
10REM*** DO MODE **
20CLS
30INPUT "Which MODE?"M%
40PROCmode (M%,&C00)
50CALL mode
60PRINT"This is MODE ";M%
70END
80:
6000DEF PROCmode (action,addr)
```

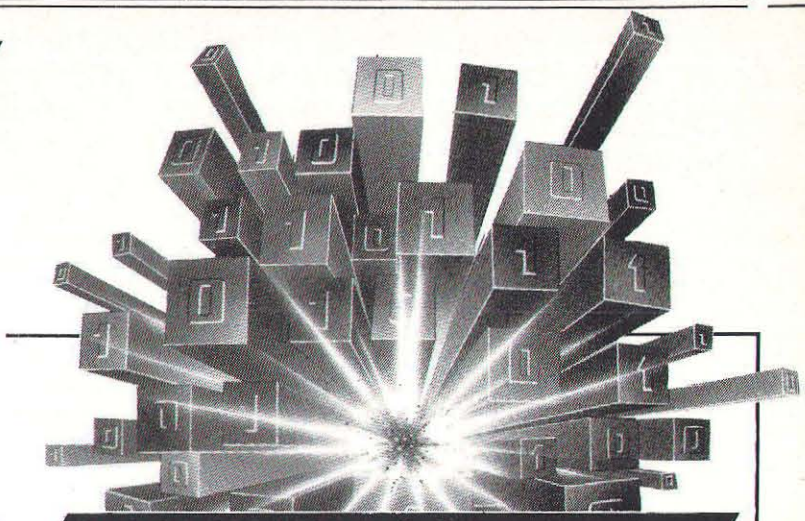
```
6184            LDA #25
6185            JSR &FFEE
6186            LDA #4
6187            JSR &FFEE
6188            LDA #xpos MOD 256
6189            JSR &FFEE
6190            LDA #xpos DIV 256
6191            JSR &FFEE
6192            LDA #ypos MOD 256
6193            JSR &FFEE
6194            LDA #ypos DIV 256
6195            JSR &FFEE
6196            RTS
6197 ]
6198 ENDPROC
6220 DEF PROCplot(code,xcord,ycord,addr)
6221 P%=addr
6222 [
6223 .plot
6224            LDA #25
6225            JSR &FFEE
6226            LDA #code
6227            JSR &FFEE
6228            LDA #xcord MOD 256
6229            JSR &FFEE
6230            LDA #xcord DIV 256
6231            JSR &FFEE
6232            LDA #ycord MOD 256
6233            JSR &FFEE
6234            LDA #ycord DIV 256
6235            JSR &FFEE
6236            RTS
6237 ]
6238 ENDPROC
```

```
6001P%=addr
6002[
6003.mode
6004LDA #22
6005JSR &FFEE
6006LDA #action
6007JSR &FFEE
6008RTS
6009]
6010ENDPROC
```

PROGRAM LISTING 3

```
   10 REM *** DO MACHINE CODE MOVE ***
   20 PROCmove(640,512,&A00)
   30 MODE 5
   40 CALL move
   50 DRAW 640,512
   60 END
   70 :
 6180 DEF PROCmove(xpos,ypos,addr)
 6181 P%=addr
 6182 [
 6183 .move
 6184            LDA #25
 6185            JSR &FFEE
 6186            LDA #4
 6187            JSR &FFEE
 6188            LDA #xpos MOD 256
 6189            JSR &FFEE
 6190            LDA #xpos DIV 256
 6191            JSR &FFEE
 6192            LDA #ypos MOD 256
 6193            JSR &FFEE
 6194            LDA #ypos DIV 256
 6195            JSR &FFEE
 6196            RTS
 6197 ]
 6198 ENDPROC
```

CONTINUED OVER



PROGRAM LISTING 4

```
   10 REM *** DO MACHINE CODE DRAW LINE
***
   20 PROCdraw(1000,1000,&C00)
   30 MODE 4
   40 MOVE 0,0
   50 CALL &C00
   60 END
   70 :
 6200 DEF PROCdraw(xcord,ycord,addr)
 6201 P%=addr
 6202 [
 6203 .draw_line
 6204            LDA #25
 6205            JSR &FFEE
 6206            LDA #6
 6207            JSR &FFEE
 6208            LDA #xcord MOD 256
 6209            JSR &FFEE
 6210            LDA #xcord DIV 256
 6211            JSR &FFEE
 6212            LDA #ycord MOD 256
 6213            JSR &FFEE
 6214            LDA #ycord DIV 256
 6215            JSR &FFEE
 6216            RTS
 6217 ]
 6218 ENDPROC
```

PROGRAM LISTING 5

```
   10 REM *** DO MACHINE CODE PLOT ***
   20 PROCplot(85,1000,1000,&C00)
   30 MODE 4
   40 MOVE 0,0
   50 MOVE 1000,0
   60 CALL plot
   70 END
   80 :
 6220 DEF PROCplot(code,xcord,ycord,addr
)
 6221 P%=addr
 6222 [OPT 2
 6223 .plot
 6224             LDA #25
 6225             JSR &FFEE
 6226             LDA #code
 6227             JSR &FFEE
 6228             LDA #xcord MOD 256
 6229             JSR &FFEE
 6230             LDA #xcord DIV 256
 6231             JSR &FFEE
 6232             LDA #ycord MOD 256
 6233             JSR &FFEE
 6234             LDA #ycord DIV 256
 6235             JSR &FFEE
 6236             RTS
 6237 ]
 6238 ENDPROC
```

PROGRAM LISTING 6

```
   10 REM *** DO PRINT COLOUR ***
   20 PROCcolour (1,&C00)
   30 MODE 2
   40 CALL colour
   50 END
   60 :
 6250 DEF PROCcolour(print_colour,addr)
 6251 P%=addr
 6252 [
 6253 .colour
 6254             LDA #17
 6255             JSR &FFEE
 6256             LDA #print_colour
 6257             JSR &FFEE
 6258             RTS
 6259 ]
 6260 ENDPROC
```

PROGRAM LISTING 7

```
   10 REM *** DO BACKGROUND COLOUR ***
   20 REM *** SET RED BACKGROUND ***
   30 PROCbackgrnd (129,&C00)
   40 MODE 2
   50 CALL backgrnd
   60 END
   70 :
 6270 DEF PROCbackgrnd (back_col,addr)
 6271 P%=addr
 6272 [
 6273 .backgrnd
 6274             LDA #17
 6275             JSR &FFEE
 6276             LDA #back_col
 6277             JSR &FFEE
 6278             LDA #12
 6279             JSR &FFEE
 6280             RTS
 6281 ]
 6282 ENDPROC
```

PROGRAM LISTING 8

```
   10 REM *** DO MACHINE CODE GCOL ***
   20 REM *** FLASHING B/W LINE ***
   30 PROCgcol (0,8,&C00)
   40 MODE 2
   50 CALL gcol
   60 MOVE 0,0:DRAW 1000,1000
   70 END
   80 :
 6285 DEF PROCgcol (action,colour,addr)
 6286 P%=addr
 6287 [
 6288 .gcol
 6289             LDA #18
 6290             JSR &FFEE
 6291             LDA #action
 6292             JSR &FFEE
 6293             LDA #colour
 6294             JSR &FFEE
 6295             RTS
 6296 ]
 6297 ENDPROC
```

PROGRAM LISTING 9

```
   10 REM**CLEAR GRAPHICS SCREEN -CLG**
   20 PROCclg (&C00)
   30 MODE 2
   40 COLOUR129
   50 CLS
   60 PRINT"PRESS A KEY TO CLEAR SCREEN"
   70 A=GET
   80 CALL &C00
   90 END
  100 :
 6300  DEF PROCclg (addr)
 6301 P%=addr
 6302 [
 6303 .clear_graphics
 6304             LDA #16
 6305             JSR &FFEE
 6306             RTS
 6307 ]
 6308 ENDPROC
```

PROGRAM LISTING 10

```
  10 REM *** DO VDU 19 ***
  20 REM** GO FRU ALL COLOURS **
  30 MODE 2
  40 FOR loop=1 TO 15
  50 PROCchange_palette (0,loop,&C00)
  60 CALL chgpalette
  70 FOR N=0 TO 999:NEXT
  80 NEXT
  90 PROCchange_palette (0,0,&C00)
 100 CALL chgpalette
 110 END
 120 :
6310 DEF PROCchange_palette (log,phy,ad
dr)
6311 P%=addr
6312 [OPT 2
6313 .chgpalette
6314             LDA #19
6315             JSR &FFEE
6316             LDA #log
6317             JSR &FFEE
6318             LDA #phy
6319             JSR &FFEE
6320             LDA #0
6321             JSR &FFEE
6322             JSR &FFEE
6323             JSR &FFEE
6324             RTS
6325 ]
6326 ENDPROC
```

PROGRAM LISTING 11

```
  10  REM *** READ LAST 2 GRAPHICS ***
  20  REM *** CURSOR POSITIONS      ***
  30  MODE 4
  40  MOVE 200,200
  50  DRAW 500,500
  60  MOVE 700,700
  70  DRAW 900,900
  80  CLS
  90  PROCgcursor(&70,&C00)
 100  CALL &C00
 110  FOR loop=&70 TO &77
 120  PRINT~loop;"   ";?loop
 130  NEXT loop
 140  END
 150  :
6330  DEF PROCgcursor(block,addr%)
6331  FOR pass=0 TO 3 STEP3
6332  P%=addr%
6333  [OPT pass
6334             LDA #13
6335             LDX #block MOD 256
6336             LDY #block DIV 256
6337             JSR &FFF1
6338             RTS
6339  ]
6340  NEXT
6341  ENDPROC
```

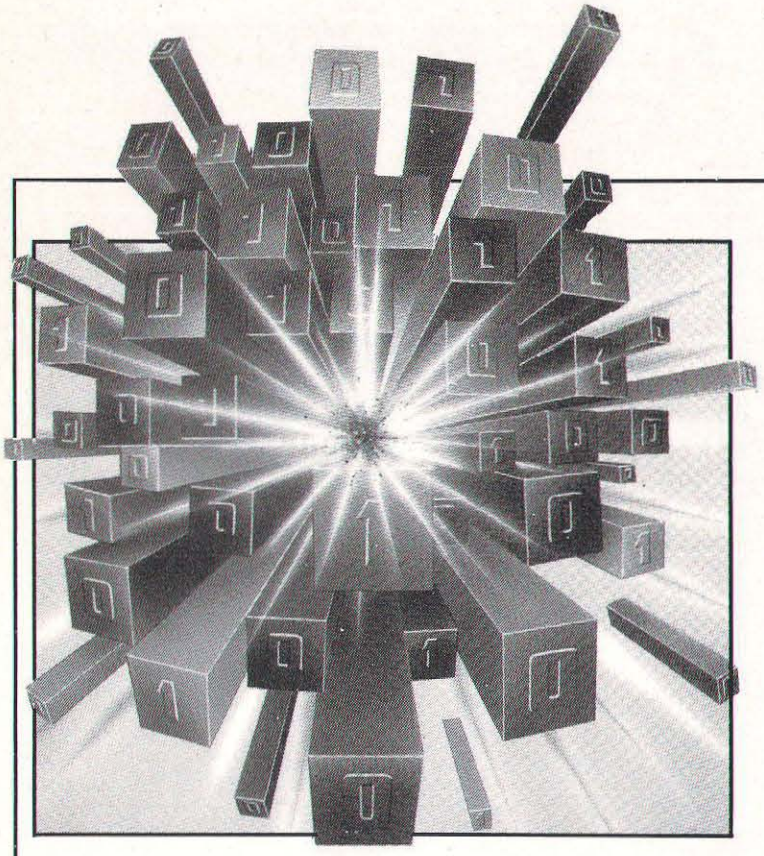
PROGRAM LISTING 12

```
  10 REM READ PIXEL VALUES
  20 PROCpixel(&70,100,100,&C00)
  30 MODE 2
  40 CALL&C00
  50 PRINT~block?4
  60 END
  70 :
6350 DEF PROCpixel(block,X,Y,addr)
6351 FOR pass=0 TO 3 STEP3
6352 P%=addr
6353 [OPT pass
6354             LDA #X MOD 256
6355             STA block
6356             LDA #X DIV 256
6357             STA block+1
6358             LDA #Y MOD 256
6359             STA block+2
6360             LDA #Y DIV 256
6361             STA block+3
6362             LDX #block  MOD 256
6363             LDY #block  DIV 256
6364             LDA #9
6365             JSR &FFF1
6366             RTS
6367 ]
6368 NEXT
6369 ENDPROC
```

PROGRAM LISTING 13

```
  10  REM *** READ COLOUR PALETTE ***
  20 MODE 4
  30 VDU19,1,3,0,0,0
  40 PROCreadpalette (&70,&C00,1)
  50 CALL &C00
  60 PRINT"Logical  colour :";?&70
  70 PRINT"Physical colour :";?&71
  80 END
  90 :
6380 DEF PROCreadpalette (block, addr%,
L%)
6381 FOR pass=0 TO 3 STEP 3
6382 P%=addr%
6383 [OPT pass
6384             LDA #L%
6385             STA block
6386             LDA #11
6387             LDX #block MOD 256
6388             LDY #block DIV 256
6389             JSR &FFF1
6390             RTS
6391 ]
6392 NEXT pass
6393 ENDPROC
```

CONTINUED OVER



PROGRAM LISTING 14

```
   10 REM *** WRITE TO PALETTE ***
   20 MODE 4
   30 PROCwritepalette (&70,0,3,&C00)
   40 CALL &C00
   50 END
   60 :
 6400 DEF PROCwritepalette (block,L%,PY%
,addr%)
 6401 P%=addr%
 6402 [
 6403              LDA # L%
 6404              STA block
 6405              LDA # PY%
 6406              STA block+1
 6407              LDA #0
 6408              STA block+2
 6409              STA block+3
 6410              STA block+4
 6411              LDA #12
 6412              LDX #block MOD 256
 6413              LDY #block DIV 256
 6414              JSR &FFF1
 6415              RTS
 6416 ]
 6417 ENDPROC
```

PROGRAM LISTING 15

```
   10 REM ** CONVERT X,Y TO ADDRESS **
   20 PROCxyaddr(&80, &72, &71,&900)
   30 REPEAT
   40 INPUT"What is the X axis value - 0
to 79  "?&71
   50 INPUT''"What is the Y axis value -
0 to 255 "?&72
   60 CALLCODE
   70 PRINT~?&80+?&81*256
   80 UNTIL0
   90 :
 6500 DEFPROCxyaddr(vector, yaxis, xaxis
, addr)
 6501 FORI%=0TO2 STEP2
 6502 P%=addr
 6503 [            OPTI%
 6504 .CODE
 6505              LDA#0
 6506              STA vector
 6507              STA  vector+2
 6508              LDA#&30
 6509              STA  vector+1
 6510              LDA yaxis
 6511              AND#7
 6512              STA yaxis +1
 6513              EOR yaxis
 6514              LSRA
 6515              LSRA
 6516              TAY
 6517              INY
 6518              LDA&C375,Y
 6519              CLC
 6520              ADC vector
 6521              ADC yaxis +1
 6522              STA vector
 6523              DEY
 6524              LDA&C375,Y
 6525              ADC  vector+1
 6526              STA  vector+1
 6527              LDA xaxis
 6528              LDX#3
 6529 .LOOP
 6530              ASLA
 6531              ROL  vector+2
 6532              DEX
 6533              BNE LOOP
 6534              ADC vector
 6535              STA vector
 6536              LDA#0
 6537              ADC  vector+2
 6538              ADC  vector+1
 6539              STA  vector+1
 6540              LDY#0
 6541              LDA#&FF
 6542              STA( vector),Y
 6543              RTS
 6544 ]
 6545 NEXT
 6546 ENDPROC
```

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LET'S GET SERIAL

Tony Wingrove

The RS423 serial port is your passport to other computing systems and devices. Read on for the fullest of briefings. . .

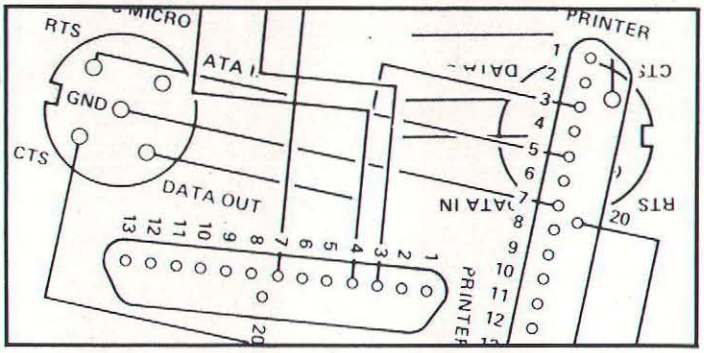
I am a member of a West London computer club and, during a recent meeting, was surprised to find how many members had two printers. A matrix printer seems the most popular first buy, to be followed when funds permit either by a daisywheel printer or one of the inexpensive colour printer/plotters now available. The proud owner is then faced with the problem of how to connect two printers to one micro.

The simplest solution is to plug in whichever printer is required! This is hardly convenient and, more important, causes rapid plug wear which leads to intermittent connections and unreliable operation.

A more elegant solution is to purchase one of the hardware switching devices which permits two printers to be connected to the BBC's parallel port. The objections to this are the cost, typically around £75, and the fact that switching is still manual, i.e. it cannot be done by software.

The solution I prefer is to connect one printer to the parallel port and the other to the RS423 serial port. Printers can then be switched either by commands input at the keyboard or from within a Basic program. This approach is aided by the fact that it is becoming increasingly easy to obtain printers with built-in serial interfaces or even both serial and parallel interfaces. Examples of the latter are some of the Tandy range and the Okidata matrix printers. Even when a serial board for the printer has to be purchased as an extra, the cost is usually less than that of a hardware printer switch. To take two popular examples, serial boards for the Epson and Juki printers are available at around £30 and £55 respectively.

A point worth bearing in mind is that serial data transfer is slower than parallel, so if you have a choice, it is best to connect the faster of your two printers to the parallel port. I use both a matrix printer and a daisywheel printer for wordprocessing. The matrix printer, which operates at 120 characters per second, is used to produce fast printout for proof reading and correction. It is connected to the parallel port for speed. The daisywheel printer, which operates at only 18 characters per second, is used solely for high quality final copy. It is connected to the serial port, where the reduced data transfer rate does not matter because of the already slow speed of the printer.



Finally, although the serial port on the BBC is an RS423 port, it will normally be compatible with the more common RS232 serial printers. I haven't experienced any problems in this respect.

The software required to operate a serial printer is straightforward, being mainly confined to use of various *FX commands. The only hardware needed is a suitable cable, though determining the correct connections can be time-consuming.

SOFTWARE

The steps involved in directing output to a printer are:

1. Select either a serial or parallel printer using the appropriate *FX5 command.
2. For a serial printer, set the correct baud rate using the appropriate *FX8 command.
3. Enable and disable the printer as required, using either CONTROL B and CONTROL C from the keyboard, or VDU2 and VDU3 from within a Basic program.

Let us look at these steps in more detail as applied to a serial printer.

SELECTING THE PRINTER

The serial printer is selected by the command *FX5,2. Reference to the User Guide shows that output to the printer and RS423 port is also controlled by the *FX3 command. It is not necessary to use this command in addition to *FX5,2 as the default setting (*FX3,0) already allows output to the printer. In particular, do not use any of the *FX3 settings which are shown as enabling RS423 output, as this will cause each character to be sent to the printer twice.

SETTING THE BAUD RATE

The baud rate is set by the command *FX8,n as shown in figure one.

Baud Rate	Command
75	*FX8,1
150	*FX8,2
300	*FX8,3
1200	*FX8,4
2400	*FX8,5
4800	*FX8,6
9600	*FX8,7
19200	*FX8,8

Fig 1

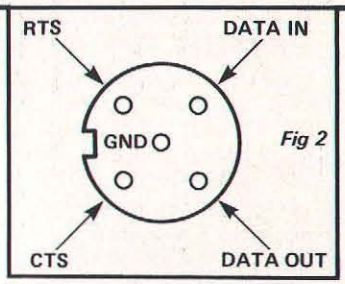


Fig 2

The absence of a 600 baud facility is annoying as several inexpensive printers, e.g. the Tandy LP VII and TP40 matrix printers, and the popular CGP-115 colour printer use this rate. Fortunately it is possible to obtain 600 baud by using the *FX156 command to reprogram the 6850 integrated circuit which controls the serial port. This is done by setting the baud rate to 150 baud by *FX8,2 and then using the command *FX156,1,253.

ENABLING/ DISABLING THE PRINTER

The commands described so far merely set up the system in preparation for the use of the printer. No output will go to the printer until it is enabled. This can be done from the keyboard by typing CONTROL B or from within a Basic program by the instruction VDU2. When printing is complete, the printer should be disabled by CONTROL C or VDU3, otherwise anything displayed on the screen will also be printed.

EXAMPLES

Here are two examples to illustrate the use of the commands. The first shows how printers can be selected and controlled from the keyboard. It is

convenient to program the function keys to do this.

```
*KEY0 |C *FX5,1 |B | M
*KEY1 |C * FX5,2 | M *FX8,4 | B | M
```

Pressing KEY0 causes output to go to the parallel printer. Pressing KEY1 causes output to go instead to the serial printer. You should, of course, use the *FX8 command appropriate for your printer's baud rate.

The reason for the |C (which means < CONTROL > C) character before the *FX5 command is to prevent the command being printed when swapping printers.

The author originally tested the above with a 600 baud printer and included the *FX156,1,253 command in the definition of KEY1. The cause was eventually found to be the way in which the command addresses bits in the control register of the 6850 chip. It does this not by setting bits, but by toggling them, i.e. 0s become 1s and vice versa. This means that the first time the command is used, the bits are set as required, but second time round, the bits are reversed. The next time the command is used, the bits are again given the required setting, and so on. A way round this is to program a third key to set the baud rate, i.e.

```
*KEY0 | C * FX5,1 | B | M
*KEY1 | C * FX5,2 | B | M
*KEY2 *FX8,2|M *FX156,1,253|M
```

Press KEY2 before starting the printing session. It should not then be necessary to use the key again unless you do anything to alter the baud rate, e.g. hitting BREAK.

The second example shows how the same options can be provided from within a BASIC program.

```
10 *FX8,2
20 PRINT "PARALLEL (P) OR SERIAL (S) PRINTER?"
30 ON INSTR ("PpSs",GET$) GOTO 40,40,60,60, ELSE 20
40 *FX5,1
50 GOTO 70
60 *FX5,2
70 VDU2
80 REM * * * INSERT PRINT COMMAND HERE * * *
90 VDU3
```

HARDWARE

There are two hardware aspects which need to be considered:

1. Configuring the printer to match the BBC serial protocols.
2. Providing a suitable cable to link the printer to the BBC micro.

CONFIGURATION

Many inexpensive printers have a fixed configuration. Others provide various options such as baud rate, number of data bits and number of start and stop bits. These options are usually selected by means of DIP switches or jumper plugs inside the printer. The protocol used by the BBC micro is 1 start bit, 8 data bits and 1 stop bit. You can set the printer to any of the baud rates provided by the BBC, but it is clearly advantageous to select as high a rate as possible.

CABLE

One can often see printer cables for the BBC micro advertised as "standard parallel cable" or "standard Centronics cable". Regretably there is no such thing as a standard serial printer cable for the BBC, for reasons which will be described shortly.

Figure two shows the 5-way DIN plug used for the serial port of the BBC micro. There have been references in other magazines stating that the diagram of this plug in the User Guide is incorrect. I have not found this to be the case. (This article was produced on a printer wired in accordance with that diagram!) Possibly the problem is that the socket on the BBC has two keyways, so the plug can be inserted either correctly or rotated through 180 degrees.

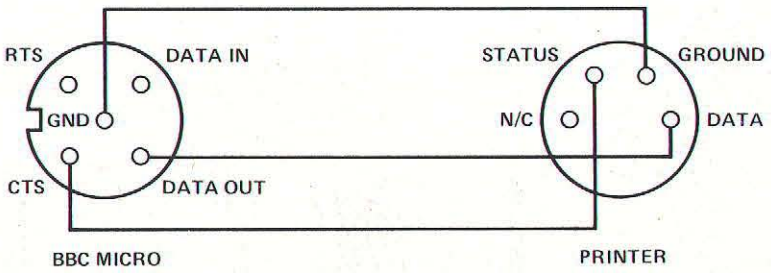


Fig 3

The functions of the Data In and Data Out lines are obvious from their names. The RTS (Request To Send) and CTS (Clear To Send) lines are status lines. The easiest way to visualise their functions is as a means of ensuring that neither the BBC nor the device to which it is connected (be it printer, modem or another computer) sends data unless the other device is ready to receive it. Clear To Send is a signal to the BBC telling it that the other device is free to accept data. Request To Send is a signal from the BBC asking the other device to send data.

Clearly a printer will not send data to the BBC micro, so the Data In line will not be needed. Similarly, the BBC will not ask for data from the printer, so the Request To Send line will also not be needed. So it looks as though we can connect a serial printer to the BBC using only three wires, namely Data Out, Clear To Send and Gnd (Ground). Can things really be that simple? The answer is yes, sometimes! As an example, take the Tandy LP VII mentioned earlier. This uses a 4-way DIN plug for its serial input. The connections specified by Tandy are:

Pin	*Function*
1	No connection
2	Status
3	Ground
4	Data

Obviously the Ground pins on the BBC and the Tandy must be linked, and the Data pin on the Tandy connects to Data Out on the BBC, but what of the Status pin? Remembering that we need a signal from the printer to the BBC telling it when the printer is ready for Data, the correct method is to link Status on the Tandy to Clear To Send on the BBC. The full connection diagram is displayed in figure three.

CONTINUED OVER

This should work first time. If not, likely causes are:

1. The Tandy printer has both serial and parallel interfaces. Ensure it is set for serial working.
2. The printer operates with either 7 or 8 data bits. Ensure it is set for 8 bits.

The same switch, located above the DIN socket, is used to select both options.

By now you are probably thinking how easy serial printers are to connect, when only three wires are needed. Let me disillusion you by introducing the 25-way D type plug (see figure four).

This is the "standard" serial connector used on many printers. The functions of the pins are listed:

1 Earth ground
2 Transmitted data
3 Received data
4 Request to send
5 Clear to send
6 Data set ready
7 Logic ground
8 Carrier detect
9 Reserved
10 Reserved
11 Unassigned
12 Secondary carrier detect
13 Secondary clear to send
14 Secondary transmitted data
15 Transmit clock
16 Secondary received data
17 Receiver clock
18 Unassigned
19 Secondary request to send
20 Data terminal ready
21 Signal quality detect
22 Ring detect
23 Transmit
24 Transmit clock
25 Unassigned

So, we have five connections coming from the BBC and about 20 pins to which they may be linked on the printer (ignoring unassigned and reserved pins). Why is this?

The reason is that the RS232 standard was never intended as a means of attaching a printer to a micro. It was originally produced to define the interface between a terminal and a modem.

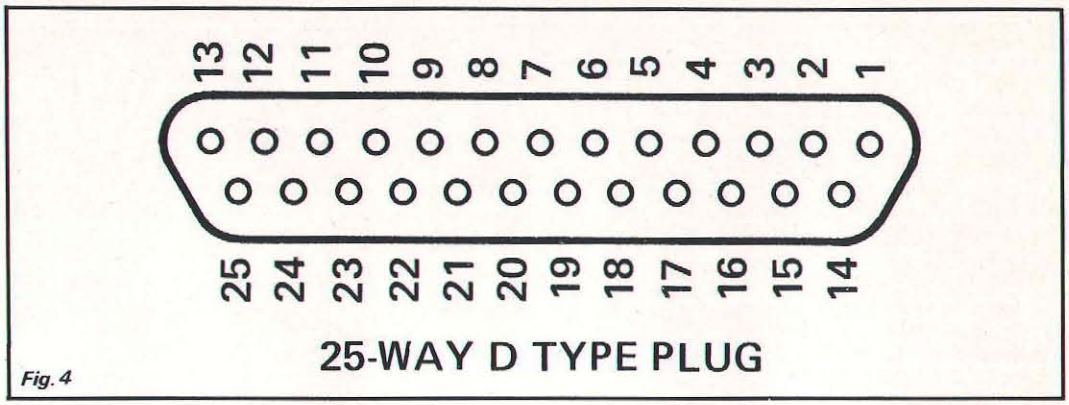


Fig. 4

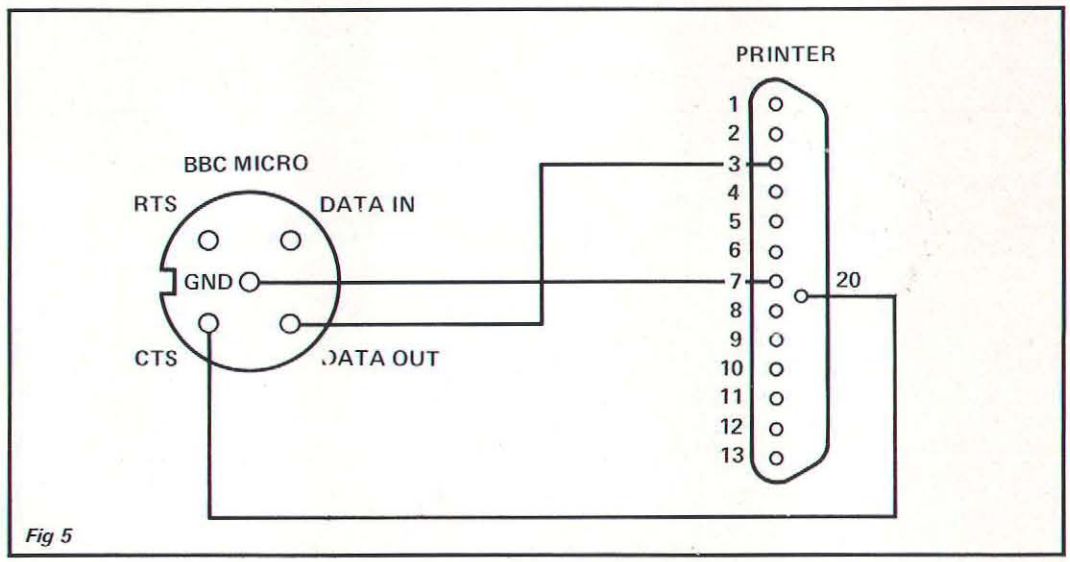


Fig 5

From our point of view, this has the advantage that many of the pins are irrelevant to printer operation and, indeed, are probably not connected inside the printer, thus reducing the number of pins we have to consider. The disadvantage is that there are several signals which can be used for status purposes, and no standardisation on their use.

How then can we decide what connection to use for a particular printer? Assuming that the printer does not give specific instructions, the author's approach is to work systematically through the possibilities described below. There are two points that make things easier:

1. The basic pins to consider are pins 1 to 7 and pin 20. It is unlikely (but not impossible) that any others will be involved.
2. We can take it that Data Out on the BBC connects to Received Data (pin 3) on the printer, and that the Ground pins are linked.

The problem thus simplifies to establishing a suitable status connection, i.e. determining which pin on the printer connects to CTS on the BBC.

In my experience, the most likely candidate is Date Terminal Ready (pin 20). The resulting connections are shown in figure five.

Another possibility is to connect Request To Send (pin 4) on the printer to Clear To Send on the BBC (see figure six).

If neither of the above methods work it may be that the printer is looking for a status signal from the computer. The only such signal available from the BBC is Request To Send. In this case you will need a four-wire connection between the printer and the BBC. Two possibilities to try are connecting Request To Send to either Clear To Send (pin 5) or Data Set Ready (pin 6) of the printer. The full connections are shown in figures seven and eight.

If neither of these work, try the connections in figures eight and nine again, but with CTS on the BBC connected to RTS (pin 4) on the printer instead of pin 20.

Should none of these methods work it is possible that

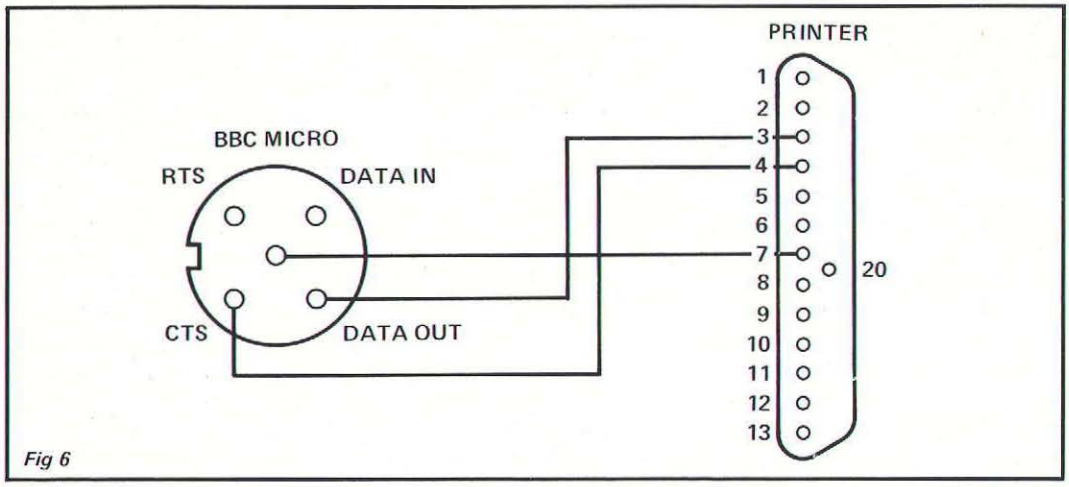


Fig 6

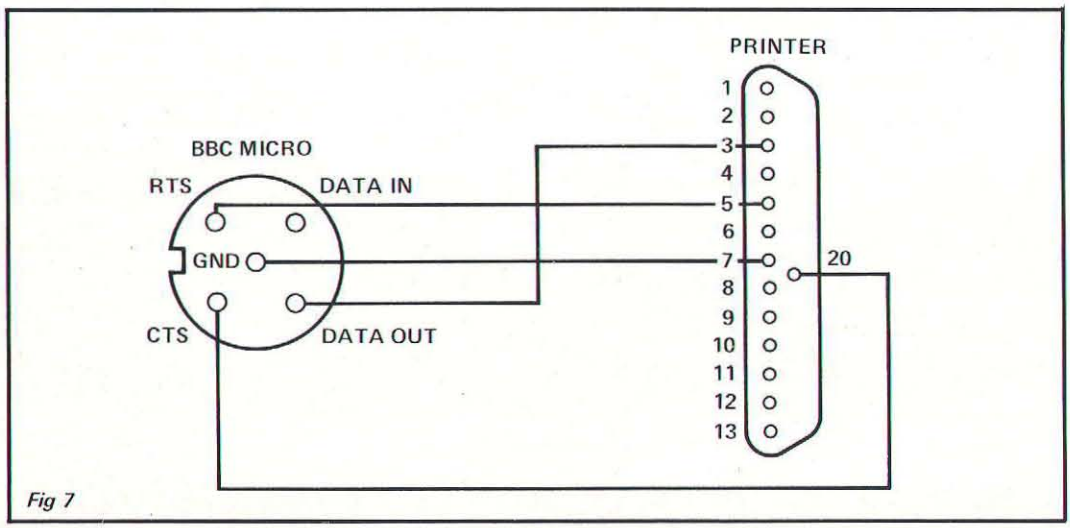


Fig 7

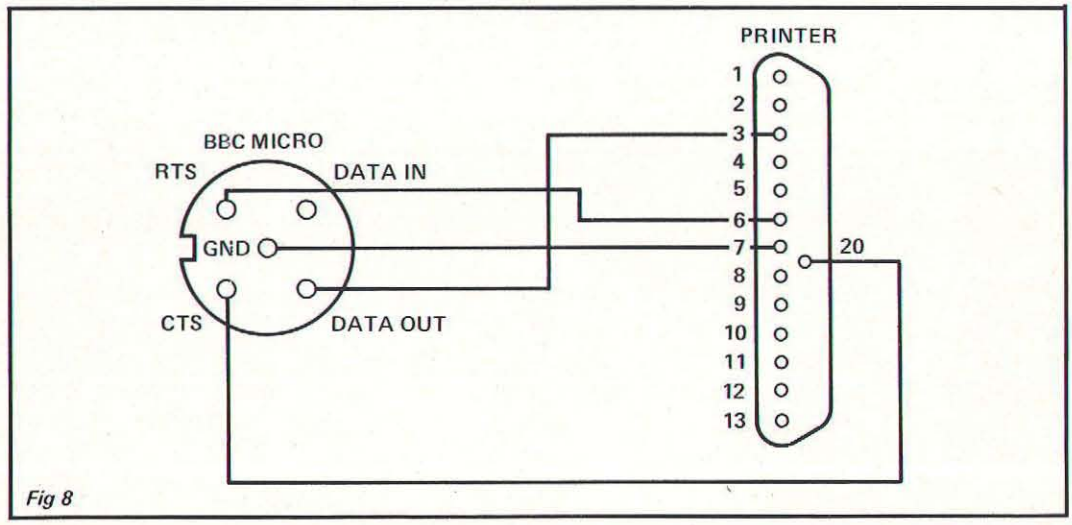


Fig 8

the printer manufacturer has made use of one of the pins defined as unassigned by the standard to provide a status signal. I have encountered a printer where pin 11 was used in this way. On no account make any connection to the unassigned pins without first consulting the printer manual. Some manufacturers use the unassigned pins for such things as power supplies or current loops. These pins may carry voltages which could damage your micro.

POSTSCRIPT

In the course of preparing this article I came across a bug in the *FX3 command. The methods described so far all result in output to the printer going to the screen as well. According to the User Guide, the command *FX3,2 should send ouput to the printer only. In fact, it results in no output to printer or screen. After trying all the *FX3 commands, it appears that any command which suppresses screen output also suppresses printer output.

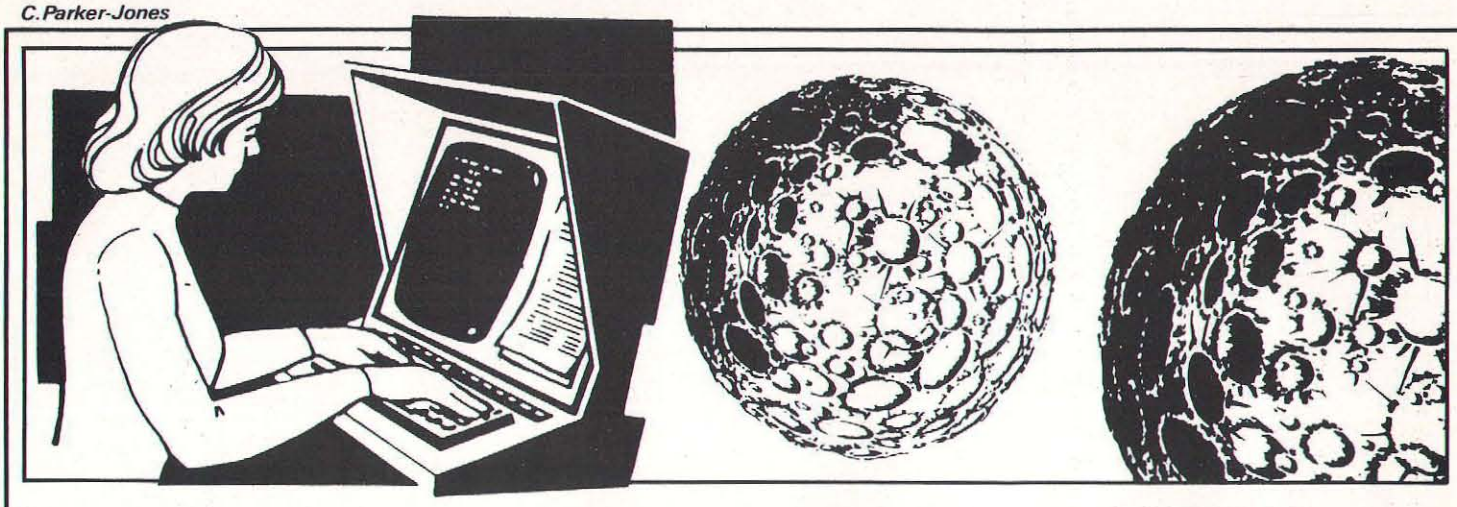
There is a potential way round this problem when using a serial printer (it will not work with a parallel printer). Instead of selecting the serial printer by *FX5,2 use the command *FX3,7. This suppresses output to both screen and printer, sending it only to the serial port. However, because the printer is connected to the serial port, output still reaches the printer and we obtained the desired result — output to the printer but not to the screen.

I suggest this as a line for experiment. I haven't investigated it in detail and there may be pitfalls in thus avoiding the printer driver routines, for instance the printer can no longer be enabled or disabled by control codes, nor can characters be suppressed by the *FX6 command.

Finally, this technique offers one other interesting possibility. If *FX3,3 is used in place of *FX3,7 and the parallel printer is selected and enabled by *FX5,1 and CONTROL B, then output goes to both printers at once!

Solar System

C. Parker-Jones



Your computer's excellent graphic capability makes it an ideal medium for demonstrating planetary movements.

I have seen very few programs written for micros which demonstrate aspects of astronomy. Micros which have good graphic capability are well suited to demonstrate astronomical events such as planets, eclipses, star charts. I, therefore, set about producing some astronomical software. The first of these programs is listed here and it demonstrates planetary orbits.

THE PROGRAM

The program consists of five procedures:

PROCmenu

The menu procedure displays three options:

1. Mercury to Mars
2. Mars to Uranus
3. Saturn to Pluto

The program prompts you to choose an option. It then proceeds to calculate the planets, plot positions and this takes approximately 35 seconds. It then prompts for a trail, if a trail is desired a flag is set e.g. TRAIL = 1.

PROCdisplay

The program then changes graphic mode to Mode 5 and prints the range of the planets. MODE 5 is the display mode, the computer will stay in this mode until the ESCAPE key is pressed.

PROCplanetloop

This procedure is the main loop which plots the Sun and each individual planet in turn by calling the procedure **PROCpltp**, and **PROCremove.**

VARIABLES USED

OPTIONS$	Variable for menu
OPTION	Stored option 1, 2 or 3
MP1	Max distance for planet one
mP1	Min distance for planet one
MP2	Max distance for planet two
mP2	Min distance for planet two
MP3	Max distance for planet three
mP3	Min distance for planet three
MP4	Max distance for planet four
mP4	Min distance for planet four
TP1	Movement variable for planet one
TP2	Movement variable for planet two
TP3	Movement variable for planet three
TP4	Movement variable for planet four
A%	Degree variable 0° to 360°
V1	Calculated SIN for degree A%
V2	Calculated COS for degree A%
PLANET (7,360)	Storage for four planets of calculated plot positions.
TRAIL	FLAG
PLPT	Planet number for array
Y(4)	Position store 0° to 360° for array
V	Used in Y(V) array
E	Erase plot variable for array
T	PROCremove

RUNNING

When running the program any error will cause it to restart. The ESCAPE key will not stop the program, to do this you will have to remove line 60.

Only four planets can be displayed at any one time, this is due to limits of screen resolution and of available memory. Therefore, the program will only run on a 32k machine.

DISPLAY

The planets are displayed around a central Sun, they move at their proper speeds (T1; T2; T3; T4). The planet with the greatest eccentricity is Pluto. If option 3 is run with a trail the display looks somewhat like a large eye. Option 1 is ideal for demonstrating the position of the planets Mercury, Venus and Mars in relation to the earth at the time when all three planets are eclipsed from earth's view (both independently or together) by the sun.

SOME ASTRONOMICAL DATA

If you wish to change the program and include or mix planets for different displays, here is a list of planetary data:

I hope this program will encourage other amateur astronomers with computers to produce programs, to help us in seeing space.

PLANET	Max dist	Min dist	Year
Mercury	69.7	45.9	.24
Venus	109	107.5	.73
Earth	152	147.5	1
Mars	250	207	1.9
Jupiter	816	740	11.86
Saturn	1507	1346	29.5
Uranus	3000	2735	84
Neptune	4537	4456	165
Pluto	7375	4425	248

All distances in millions of kilometres.

PROGRAM LISTING

```
   5REM DISC SYSTEMS DELETE REMS OR MOVE PROGRAM
TO &E00
  10 REM SOLAR SYSTEM  AUTHOR C.PARKER-JONES
  20 REM ONLY 4 PLANETS CAN BE DISPLAYED AT
  30 REM ANY ONE TIME..
  40 REM ALTER SCREEN POSITION
  50 *TV255
  60 ON ERROR IF ERR=17 THEN CLEAR:RUN
 100 MODE 7:CLS
 105 VDU22,7,23;8202;0;0;0;
 109 REM PRINT MENU FOR OPTIONS
 110 PROCmenu
 120 MODE5
 129 REM MAIN PROGRAM STARTS
 130 PROCdisplay
 140 PROCplanetloop
 900 END
2999 REM PLOT PLANET ONTO SCREEN
3000 DEFPROCPLTP
3001 REM REMOVE TRAIL
3005 IF TRAIL >1 THEN PROCREMOVE
3010 MOVE 640,512
3020 PLOT 69,PLANET(PLTP,Y(V)),PLANET(PLTP+1,Y(V)
)
3040 ENDPROC
3099 REM REMOVE TRAIL BY PLOTTING A SPACE FROM TH
E LAST PLOT
3100 DEFPROCREMOVE
3110 MOVE 640,512
3120 T=Y(V)-E
3130 PLOT 71,PLANET(PLTP,T),PLANET(PLTP+1,T)
3140 ENDPROC
3999 REM PLANET LOOP
4000 DEFPROCplanetloop
4009 REM PLOT SUN
4010 GCOL 0,2:PLOT 69,640,512
4020 GCOL0,3
4030 REPEAT
4099 REM PLANET 1
4100 PLTP=0:V=1:E=TP1:IF E<1 THEN E=1
4110 Y(1)=Y(1)+TP1:IF Y(1)<360 THEN PROCPLTP
4120 IF Y(1)>=360-E THEN E=0:PROCREMOVE:Y(1)=0
4199 REM PLANET 2
4200 PLTP=2:V=2:E=TP2:IF E<1 THEN E=1
4210 Y(2)=Y(2)+TP2:IF Y(2)<360 THEN PROCPLTP
4220 IF Y(2)>=360-E THEN E=0:PROCREMOVE:Y(2)=0
4299 REM PLANET 3
4300 PLTP=4:V=3:E=TP3:IF E<1 THEN E=1
4310 Y(3)=Y(3)+TP3:IF Y(3)<360 THEN PROCPLTP
4320 IF Y(3)>=360-E THEN E=0:PROCREMOVE:Y(3)=0
4399 REM PLANET 4
4400 PLTP=6:V=4:E=TP4:IF E<1 THEN E=1
4410 Y(4)=Y(4)+TP4:IF Y(4)<360 THEN PROCPLTP
4420 IF Y(4)>=360-E THEN E=0:PROCREMOVE:Y(4)=0
4499 REM LOOP LAST FOREVER
4500 UNTIL FALSE
4999 REM MENU
5000 DEF PROCmenu
5010 CLS:REPEAT
5020 PRINT TAB(0,0)CHR$130"The Solar System Autho
r C.Parker-Jones."
5030 PRINT TAB(16,6)CHR$133"MENU"
5040 PRINT TAB(10,8)"1. Mercury to Mars"
5050 PRINT TAB(10,10)"2. Mars to Uranus"
5060 PRINT TAB(10,12)"3. Saturn to Pluto"
5078 REPEAT:OPTION$=" "
5080 PRINT TAB(8,20)CHR$134"Enter Option ";
5090 OPTION$=GET$
5100 OPTION=VAL(OPTION$)
5110 UNTIL OPTION=1 OR OPTION=2 OR OPTION=3
5120 PRINT TAB(0,20)STRING$(39," ")
5130 IF OPTION=1 THEN PRINT TAB(0,8)CHR$129
5140 IF OPTION=2 THEN PRINT TAB(0,10)CHR$129
5150 IF OPTION=3 THEN PRINT TAB(0,12)CHR$129
5160 PRINT TAB(4,20)CHR$136"Working...."
5169 REM LOAD VARIABLES INTO ARRAYS
5170 DIM PLANET(7,360),Y(4):Y(1)=4:Y(2)=2:Y(3)=2:
Y(4)=2
5179 REM MERCURY TO MARS
5180 IF OPTION=1 THEN MP1=139.4:mP1=91.84:TP1=4:M
P2=218:mP2=214.8:TP2=1.64:MP3=304.2:mP3=294.2:TP3=
1:MP4=498.2:mP4=413.4:TP4=.66
5189 REM MARS TO URANUS
5190 IF OPTION=2 THEN MP1=35.6:mP1=29.53:TP1=4:MP
2=116.53::mP2=105.84:TP2=.63:MP3=215.3:mP3=192.43:
TP3=.26:MP4=429.14:mP4=390.71:TP4=.09
5199 REM SATURN TO PLUTO
5200 IF OPTION=3 THEN MP1=100.47:mP1=89.8:TP1=4:M
P2=200.27:mP2=182.33:TP2=1.4:MP3=302.47:mP3=297.07
:TP3=.72:MP4=491.67:mP4=290:TP4=.48
5499 REM WORK OUT PLOTS
5500 FOR A%=0 TO 360
5510 V1=SIN(RAD(A%)):V2=COS(RAD(A%))
5520 PLANET(0,A%)=640+(MP1*V1):PLANET(1,A%)=512+(
mP1*V2)
5530 PLANET(2,A%)=640+(MP2*V1):PLANET(3,A%)=512+(
mP2*V2)
5540 PLANET(4,A%)=640+(MP3*V1):PLANET(5,A%)=512+(
mP3*V2)
5550 PLANET(6,A%)=640+(MP4*V1):PLANET(7,A%)=512+(
mP4*V2)
5560 NEXT A%
5699 REM ASK FOR TRAIL
5700 PRINT TAB(0,20)STRING$(39," ")
5710 REPEAT:TRAIL=0
5720 PRINT TAB(8,20)"Trail Y or N ";
5730 OPTION$=GET$
5740 IF OPTION$="Y" THEN TRAIL=1
5750 IF OPTION$="N" THEN TRAIL=2
5760 UNTIL TRAIL<>0
5770 OPTION$=" ":A%=0:MP1=0:MP2=0:MP3=0:MP4=0:mP1
=0:mP2=0:mP3=0:mP4=0
5800 ENDPROC
5999 REM DISPLAY OPTION
6000 DEF PROCdisplay
6020 COLOUR 2
6100 PRINT TAB(0,0);:IF OPTION=1 THEN PRINT"Mercu
ry to Mars."
6110 IF OPTION=2 THEN PRINT"Mars to Uranus."
6120 IF OPTION=3 THEN PRINT"Saturn to Pluto."
6150 ENDPROC
```

A Nightingale Sings

Tony Self

Using computers for communications is increasing in popularity amongst Beeb users. In our October issue we had a general look at the various modems that are available.

This month we are going to look in detail at the package available from Pace. This consists of the Nightingale direct connect modem and the Commstar communication ROM.

THE HARDWARE

I will start by covering the Nightingale, mainly because I did not have the Commstar ROM initially for reasons best known to the editor. The modem arrives in a polystyrene package, which should provide adequate protection in the post. Inside the packaging you find the installation instructions, RS423 lead and the actual modem.

The modem is housed in a plastic case measuring about 7" × 8" × 2½" with a brushed bronze effect control panel. From the rear of the case run two leads, one for the telephone jack, about 10' long (you will need a new style BT telephone point for this), and the mains cable, about 6' long, which is fitted with a moulded mains plug. A nice touch that, it saved me rummaging around the house looking for a plug I could cannibalise.

There is also a socket on the rear of the case which accepts the jack from your own phone. This can then sit on top of the modem, though a standard phone does hang over the front and back of the unit. A slightly larger case would have solved this small but rather niggling problem.

It was a simple operation to connect everything up. The only area where you have to be a bit careful is to make sure you insert the RS423 plugs the right way up.

The control panel consists of four push buttons and two LEDs. Working from the left, the first button is the "Modem connect". You use this after dialling the host system and hearing the carrier signal — this modem does not have an auto-dial facility.

PACE communications package. Nightingale and Commstar.



Next comes an orange LED which lights when the "Modem connect" has been depressed and the unit detects the carrier signal. This is followed by another LED which has three functions. Firstly it glows red when the unit is plugged in to indicate power on. This highlights my first major gripe, there is no mains on/off switch — I am forever finding the following day that I have left the unit plugged in all night. This LED is also used to indicate whether characters are being sent or received. It glows a brighter red when receiving and green when characters are being sent.

The last three buttons are used to set the mode of operation. The middle button selects either 300/300 full duplex or Viewdata baud rates. The first of these three then selects either originate or answer, or Tx1200/Rx75 or Rx1200/Tx75. The last button is used to select the tones required for either CCITT (Euro) or Bell (USA) standards, so enabling you to contact bulletin boards in the USA if your pocket can afford it.

There is another button on the back of the unit which is used for self testing the modem. However, you can only use this in 300/300 full duplex operation. As I didn't have Commstar initially I couldn't try this facility out, so, my first test was to use my existing Micronet software.

I first used the Micronet ROM software and experienced no problems until I tried to download a program. As soon as I pressed function key 5 the modem disconnected. A phone call to PACE explained the problem. Apparently the Micronet ROM software affects the memory location which reflects the CTS signal on the RS423. If CTS goes low the modem will disconnect. Pace do supply a different lead which cuts out this problem for Micronet ROM users.

Seeing that there are obviously problems using the ROM software I then tried using the Version 4.0 software I have on disc. This behaved quite normally without any download problems. I must say it is a joy to be able to view the graphic frames and download programs without the inevitable data corruption I get with my acoustic modem.

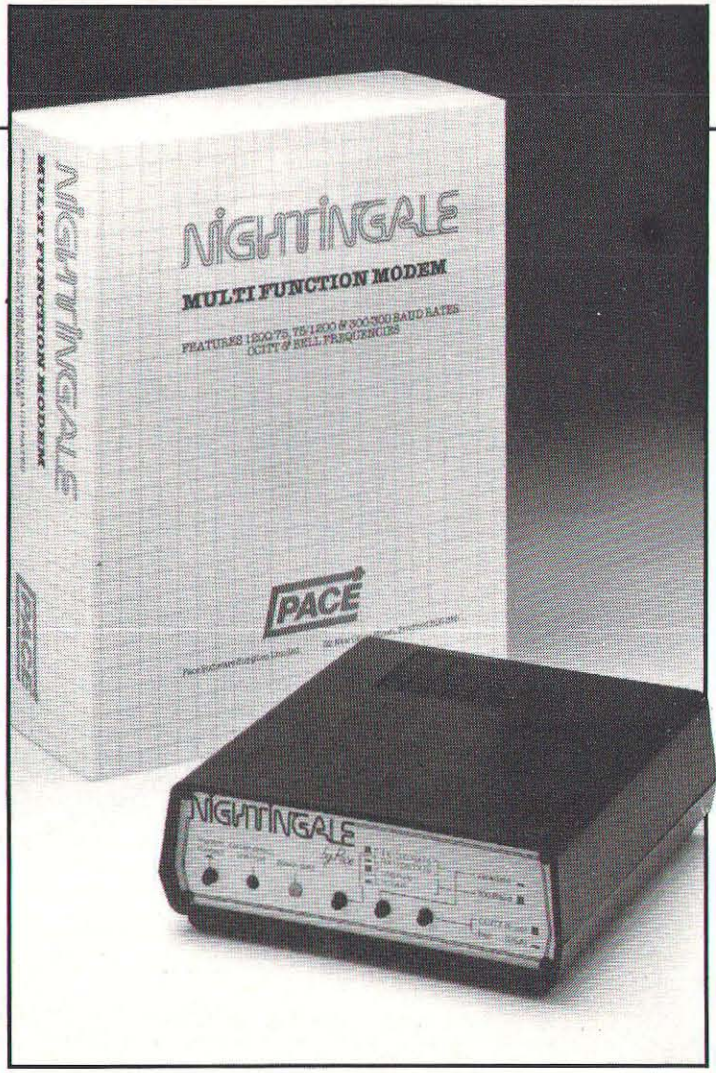
THE FIRMWARE

Eventually I had access to the Commstar ROM. This is quite a comprehensive package and comes with a detailed manual of some 100 pages. The manual is well laid out, with sections on each of the facilities provided. For those of you who are already experienced in communications there are sections which will guide you quickly through the routines needed to get the system up and running.

The 8K ROM is fitted, as usual, in one of the spare sideways ROM sockets. The ROM is accessed by " *COMMSTAR" or " *C *" — don't try using " *C." if you have a DFS fitted as you will end up compacting your disc.

On accessing the ROM a comprehensive menu is displayed in mode 7. The menu is well laid out and can be split into three sections. The heading shows the current emulation. Commstar has two built in emulations — Terminal and Prestel. The default emulation is Terminal. It is also possible to load in other emulations from your current filing system.

Pace are currently writing software for some of the more common emulations such as VT100 and also supply details on how to write your own. The next section is the main command panel, which again is split into three sections — buffer com-



mands, flag toggles and general purpose commands. Each command is normally accessed by a single key press.

The bottom part of the screen is given over to status information, which shows the current state of all the flags and details of the buffer space. An elapsed time clock is displayed in the top right hand corner. This is also displayed in "Chat" mode when using mode 7. The clock is reset on start up by pressing break or using f8 "Chat" mode.

While in "Chat" mode f4 will toggle the clock display on and off. I did discover a bug here. If you are using "Chat" mode in mode 7, pressing Escape to get back to the main menu loses the clock. The only way to get it back is to press break. This rather defeats the object of having a time elapsed clock.

USING THE SYSTEM

Without the addition of specific emulations, Commstar provides three main functions: 1 — to communicate with bulletin boards, 2 — to act as a Viewdata terminal, e.g. Prestel, 3 — to allow easy user to user communication.

I will deal with each of these functions in turn. Contacting a bulletin board is simplicity itself. You may have to initialise first, but Commstar's default settings have seemed to work with the majority of boards I have used. Having selected the screen mode you want, just enter "Chat" mode and dial the number.

This is where you probably will have problems — the numbers appear to be permanently engaged and you wish you had bought one of those phones with the last number redial facility. Once you are through and hear the tone, press the "Modem connect" button and you are away. If you get "gobbledegook" up on the screen the protocols are not correct and it will be necessary to alter these by going via the main menu to the initialising option. If you don't take too long you will probably be ale to get back to "Chat" mode before the host computer times-out and drops the line.

Once you are on-line it is just a matter of selecting the options made available to you by the bulletin board. Commstar allows you to take hard copy of all or part of your session by using f3 to toggle your printer on and off. Alternatively, you can copy to the buffer using f1 and then use the View buffer option from the main menu after you have signed off if you want hard copy.

As a Prestel terminal I was very disappointed. Very few of the keys have been reprogrammed to help you round Prestel, the most annoying being the "*" which you can only obtain in the normal manner using the shift key. Fortunately they have reprogrammed the return key to produce a "#" and f8 and f9 to produce "re-display current page" and "return to previous page" respectively.

There is only one special facility, and that is the ability to tag frames for later recall. Another annoying omission is not being able to dump the screen to a printer directly. The only way to do it is to save the screen using the copy key and later using a separate screen dump routine to print out the hard copy. As far as I am concerned I will not be using Commstar for Prestel.

Finally I tried using Commstar for user to user communication. The main benefit here is to be able to send programs to one another. I must thank Philip Nichols for his help in testing out Commstar's file transfer facilities into the early hours of one Saturday morning.

The file transfer option is very easy to use. First call up your friend and agree on your protocols. You will need "Local Echo" on if you want to see what you are sending. You can then connect the modems and move into "Chat" mode. I must admit that after we had checked that we were receiving each other OK, we used the telephone more than "Chat" mode to talk to each other.

Sending a program is easy. You can either send from your buffer or direct from disc. First either load your buffer with the program you want to send or toggle the Disc option. Make sure your friend has put his machine into receive mode then you can select send mode. If you are transferring direct from disc you will be prompted for a file name. The fill will be sent in blocks of 128 bytes and the screen display shows which blocks are being sent and whether re-transmission is required because of line noise.

Our trials proved very successful, apart from one problem we had with a telephone at one end of the line. I wouldn't recomend sending lengthy programs by 300/300, it did seem to take an age, but the 1200/75 option appeared quite respectable.

VERDICT

I was not overly impressed by the Nightingale modem. It serves its purpose but it does seem expensive compared to some of the other modems which are coming onto the market at the moment. I was disappointed not to see a proper 1200/1200 half duplex operation which is available on some of the cheaper modems.

However, Commstar I liked. Apart from its limitations with Prestel it is a very nice piece of firmware, well written and very well documented.

Suppliers: Pace Software Ltd., Bradford, Tel. 0274-729306		
Prices:	Nightingale modem	£119.00 + vat
	Commstar eprom	£ 29.57 + vat
	Complete package	£139.00 + vat

Analyser

Trevor Attewell

Circuit analysis by software.

Electronics now plays such an important role in our lives that CAD (Computer Aided Design) is becoming of interest to the layman as well as the professional engineer. At one time the calculation of circuit performance involved hours of weary algebraic slog, all too often frustrated by human slip-ups (sometimes on page 1!).

The alternative of design by soldering-iron is unscientific, wasteful in components, gives little insight into the factors involved and often takes longer. The arrival of mainframes with CAD library programs came as a great, but expensive, relief. These two programs from Number One Systems, themselves circuit design consultants, put CAD firmly into the home D-I-Y category.

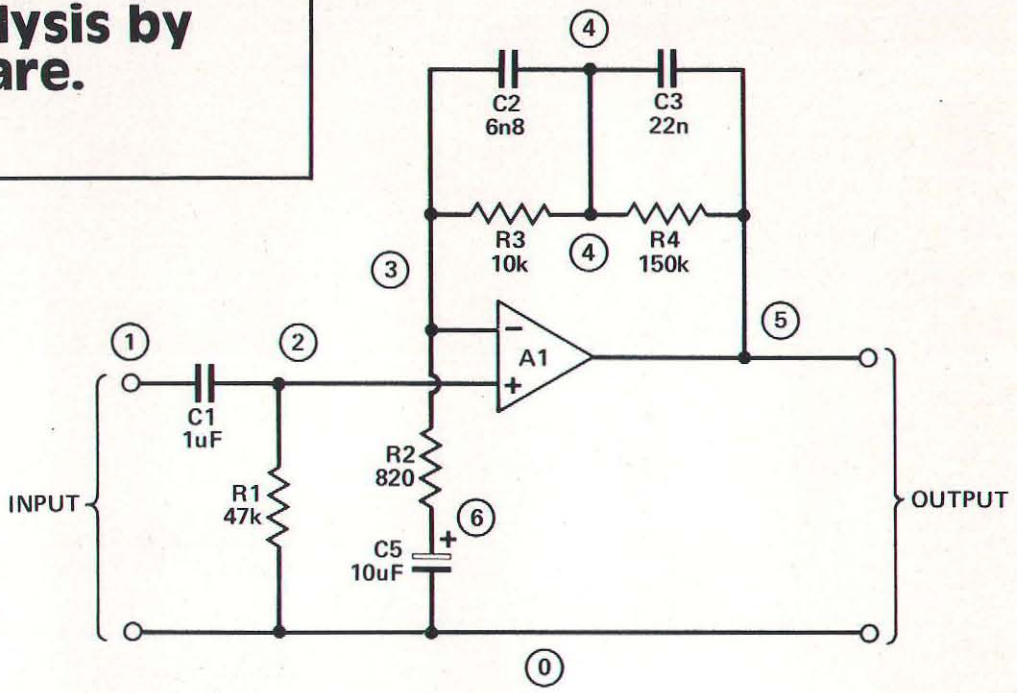
While many engineers will be familiar with computer circuit analysis, the appendix may help those who have not travelled this way before.

Of the two versions, ANALYSER I will be adequate for much home and small business use, and we will look at this version in some detail before considering the enhanced and extended ANALYSER II, which is aimed particularly at the professional circuit designer.

Both are compatible with the 6502 second processor. Throughout the review we shall adopt the loose engineering practice of using the term "matrix" to cover determinants also.

ANALYSER I is available on disc at £45.00 or cassette at £35.00, including VAT. These prices include free software updates in case of any subsequent improvement for up to six months after purchase.

It carries out steady-state ac analysis on linear networks containing any or all of the following: resistors, capacitors, inductors, bipolar transistors and/or fets, operational amplifiers and transformers. Up to 15 nodes and 60 components can be handled. Full instructions with examples are given in the 13 A4 sheets which comprise the manual.




```
CIRCUIT NAME: RIAA  28:9:84

     Component list:

R1          0          2          47000
R2          3          6          820
R3          3          4          10000
R4          4          5          150000
C1          1          2          1E-6
C2          3          4          6.800000001E-9
C3          4          5          2.2E-8
C5          6          0          1E-5
A1          2          3          5
P           1          5          0

TEST RESULTS    Gnom=25 dB
```

GETTING GOING

Chaining the program produces the title page and this prompts for the date, which is attached for reference if you later save or print your work. Return enters a null string. The main menu then appears, with eight options. Option 1 defines a new circuit, the only choice after a cold start unless previously saved circuit data is available. Option 2 modifies an existing circuit and option 3 starts the analysis.

Options 4 and 5, respectively, load and save circuit data, and option 8 catalogues the filing system to allow checking for existing or locked files.

Option 7 enables a change of circuit name — useful if data is modified. A "hidden" option accesses a sample circuit, held in data statements, if "y" is entered. This circuit can be used for familiarisation, and sample results are provided.

Option 1 produces a fixed screen heading which lists the order and type of data expected

Frequency	Gain(dB rel)	Phase (deg)	Group delay
20.00	17.18	32.46	7.85m
50.00	17.09	-17.27	2.66m
100.00	13.57	-43.78	762.22u
200.00	8.68	-55.18	84.13u
500.00	2.79	-51.89	-51.60u
1.00k	-87.74m	-47.34	-3.06u
2.00k	-2.62	-51.67	17.34u
5.00k	-7.94	-63.61	5.10u
10.00k	-13.18	-65.68	-1.04u
20.00k	-18.31	-58.19	-2.45u
30.00k	-20.80	-49.73	-2.18u
50.00k	-23.03	-37.06	-1.37u
70.00k	-23.93	-29.23	-850.55n
100.00k	-24.49	-22.47	-452.51n

ANALYSER I — Printed results for the preamplifier gain relative to a nominal figure of 25 dB. The response could stand some improvement!

for each component, starting with the component type identification letter and serial number, followed by the nodes to which it is connected and its relevant parameters. For example a 2K7 resistor connected between nodes 5 and 9 might be entered as R8,5,9,2700 — each item between commas is entered separately. Errors or deletions are easy to handle.

When all components have been dealt with an end-of-file marker (P) is entered as the component type, followed by the numbers of the input, output and grounded (or common) nodes. The component list is then displayed and a key press reinstates the menu. Any data errors noted in the list can be rectified by using option 2 — only the components concerned need be re-entered. The circuit can be saved and a prompt is issued for the filename which defaults to TEST. The default analysis parameter is voltage gain, but option 4 changes it to input or output impedance if required.

ANALYSER GOES TO WORK

On calling the analysis option there is a brief wait, during which the program produces an internal conversion table which is used to renumber the nodes so that the input node number is 0, the output node is 1 and the common node is 2, regardless of their original numbering. This allows redefinition of these nodes at any time by changing the end-of-file data, giving great flexibility in changing input and output points, examining internal impedances and so on.

The program then sets up four frequency-independent matrices from which the necessary real and imaginary admittance matrices will be derived for each frequency (see appendix).

Next you are prompted for frequency data. This can be a fixed frequency, a number of linear or logarithmic steps (50 maximum) between frequencies of your choice or a set of resident frequencies from 20Hz to 100kHz, with intervals based on the 1,2,5,7,10,. . .series. You may then choose the form of the results.

For voltage gain the options are: dB absolute (reference unity gain), dB relative to a figure which you supply, linear absolute, linear relative (all these are gain moduli) or the real and imaginary components of the gain. The default is dB absolute. Similar choices are available for input and output impedance.

Finally you are asked whether you require the group delay, and warned that this doubles the run time. The reason is that group delay is the rate of change of phase angle with frequency, calculated by incrementing the frequency by an arbitrarily small amount and finding the corresponding phase change. This naturally involves a second calculation at each nominal frequency.

Headings for the results table then appear, followed by the results at each frequency as they are determined. Paged mode is engaged if necessary.

On completion you are offered a printout, which starts with the circuit name and date, followed by the component list and the results. You can then start another frequency run or return to the menu.

The program is very easy to use. The minimum number of keystrokes are needed, and there is always a default, either to something sensible or to previous values if available — a very nice feature.

Pressing Escape at any time restores the menu, leaving data intact. Essential validation is carried out on data entries. As a rough guide to speed, the circuit shown, with 7 nodes and 9 components, needed two seconds per frequency excluding group delay. If that isn't fast enough then your Project must be in big trouble!

NOT BUGS — JUST PARASITES!

The way in which parasitic components (stray capacitance etc) are treated is very practical. A capacitor of 0.2 pF is automatically paralleled with each resistor — you can take it out if you wish, but it is a minimal fact-of-life addition. The operational amplifier has 0.2 pF from input to input, and 2 pF from each input to supply (ground), with a fixed unity-gain frequency of 3MHz and an output resistance of 100 ohms. Each transformer has one ohm in series with the secondary winding (a finite resistance in one winding is a mathematical necessity), but you would hardly need less than this, and can always add more.

A hybrid-pi model is used for bipolar transistors, the internal base-emitter resistance being calculated from the collector current which you have specified, and the associated capacitance is determined from the cut-off frequency (fT), again supplied by you.

The built-in collector-base and collector-emitter capacitances are 5 pF and 1 pF respectively. FETs are described simply by their transconductance, while capacitors and inductors are entered without parasitic additions, because these vary greatly between different types.

TRIAL AND ERROR

ANALYSER has been tested on a wide range of circuits with great success. Where the answers occasionally seemed unlikely it subsequently proved that they were correct, and that the assumed operation of the circuit was wrong in some particular. To check its accuracy it was used on two low-frequency circuits previously analysed on a mainframe using double-precision arithmetic with the results rounded to nine significant figures. Both circuits contained sharp notch filters, which can be a good test of number-crunching.

Over most of the frequency range the two sets of answers agreed exactly to the number of significant figures displayed by ANALYSER. The worst error was one part in 5000 within the filter notch, assuming that the mainframe answers were at least an order of magnitude more accurate. Unless your designs use only NPL certified components you need lose little sleep! In this exercise some extra significant figures in the frequency column would have been a help, though manual interpolation is easy.

Like most such programs this one does not explicitly handle floating inputs and outputs, eg in bridges or balanced circuits. These are simply dealt with by adding balance/unbalance transformers.

Loosely-coupled transformers (tuned or aperiodic) are not included but can be substituted by suitable equivalent circuits, though these may need extra nodes plus the odd back-of-envelope (or back to Basic?) calculation.

ANALYSER II — BIGGER & BETTER

This version is for disc use only — it comprises several programs, with overlays and data files,

CONTINUED OVER

```
Number One Systems Linear Circuit Analysis Program ANALYSER II  (C) 1984.
CIRCUIT NAME  RIAA    28:9:84
Results list gives actual analysis frequencies.  Remainder on graph are interpolated.
                                                    GAIN G,*      PHASE P,+      DELAY D      ANY TWO £

Gain(dB abs)      -5        0         5        10        15        20        25        30        35        40        45
                  .....+....:....+....:....+....:....+....:....+....:....+....:....+....:....+....:....+....:....+.....
  20.00 Hz        .         .         .         .         .         .         .         .         .         .   G D . P
  24.88 Hz        .         .         .         .         .         .         .         .         .    d    . + *   .
  30.95 Hz        .         .         .         .         .         .         .         .    d    .+        .   *   .
  38.51 Hz        .         .         .         .         .         .         .D        P.        .         .   G   .
  47.91 Hz        .         .         .         .         .         .    d    +.        .         .         .   *   .
  59.60 Hz        .         .         .         .         .    d    +.         .         .         .         . *   .
  74.15 Hz        .         .         .         .     D P .         .         .         .         .         .G    .
  92.25 Hz        .         .         .        .d+        .         .         .         .         .         *.    .
 114.76 Hz        .         .         .    + d .         .         .         .         .         .    *    .     .
 142.77 Hz        .         .         P   D     .         .         .         .         .         .  G      .     .
 177.62 Hz        .         .     +   . d       .         .         .         .         .         *         .     .
 220.97 Hz        .         .    +    .d       .         .         .         .         .    *    .         .     .
 274.90 Hz        .         .   P     D        .         .         .         .         .  G      .         .     .
 342.00 Hz        .         .   +     d        .         .         .         .        .*         .         .     .
 425.47 Hz        .         .     +   d        .         .         .         .      *  .         .         .     .
 529.31 Hz        .         .       P D        .         .         .         .    G    .         .         .     .
 658.50 Hz        .         .         £        .         .         .         .  *      .         .         .     .
 819.22 Hz        .         .         d+       .         .         .         . *       .         .         .     .
   1.02kHz        .         .         D P      .         .         .         G         .         .         .     .
   1.27kHz        .         .         d +      .         .         .        *.         .         .         .     .
   1.58kHz        .         .         £        .         .         .     *   .         .         .         .     .
   1.96kHz        .         .         PD       .         .         .   G     .         .         .         .     .
   2.44kHz        .         .     +   d        .         .         . *       .         .         .         .     .
   3.04kHz        .         .  +      d        .         .         .*        .         .         .         .     .
   3.78kHz        .         P         D        .         .        G.         .         .         .         .     .
   4.70kHz        .      +  .         d        .         .     *   .         .         .         .         .     .
   5.85kHz        .    +    .         d        .         .  *      .         .         .         .         .     .
   7.28kHz        .  P      .         D        .        G.         .         .         .         .         .     .
   9.05kHz        .  +      .         d        .     *   .         .         .         .         .         .     .
  11.26kHz        .   +     .         d        .  *      .         .         .         .         .         .     .
  14.01kHz        .     P   .         D       G.         .         .         .         .         .         .     .
  17.43kHz        .         +         d     *  .         .         .         .         .         .         .     .
  21.68kHz        .         .  +      d  *     .         .         .         .         .         .         .     .
  26.97kHz        .         .     P   £        .         .         .         .         .         .         .     .
  33.56kHz        .         .       * d +      .         .         .         .         .         .         .     .
  41.75kHz        .         .     *   d     +  .         .         .         .         .         .         .     .
  51.94kHz        .         .  G      D        .  P      .         .         .         .         .         .     .
  64.61kHz        .         .  *      d        .     +   .         .         .         .         .         .     .
  80.38kHz        .         . *       d        .      + .         .         .         .         .         .     .
 100.00kHz        .         .G        D        .        . P       .         .         .         .         .     .
                  .....+....:....+....:....+....:....+....:....+....:....+....:....+....:....+....:....+....:....+.....
Phase (deg)      -70       -60       -50       -40       -30       -20       -10        0        10        20        30
Delay (secs)     -2m       -1m        0        1m        2m        3m        4m        5m        6m        7m        8m
```

ANALYSER II — Printer-plotted results for the absolute gain, phase-shift and group delay of the RIAA circuit. 14 results were actually calculated, logarithmically spaced in frequency.

totally nearly 50K, and costs £132.25, inclusive of updates (as for ANALYSER I). The system and/or data discs can be on any drive. It copes with up to 27 nodes (30 in some circumstances) and 100 components, though you can save calculation time by opting to use 19 nodes or less.

A configuration program copes with alternative printers, allowing serial or parallel operation, auto line feed or not, variable line length, and the choice of various printer parameters. The defaults are Epson codes, condensed mode, 132 characters/line. This program also allows PAGE setting for different disc filing systems.

ANALYSER II holds a library of bipolar and field-effect transistors and operational amplifiers, each with a typical manufacturer's type number. These models are more comprehensive than those of ANALYSER I, including rbb', Cb'c and Cbe in bipolar transistors, and Cgd, Cds and Cgs in fets, which greatly improve high frequency accuracy. Primary inductance is included in transformers.

In addition all models and all parameters can be amended by the user. Each model is called up by a simple code and any quantity of each can be used, the type number appearing in the component list. A simple bipolar transistor (as in version I) may also be used — this saves a node and is good enough for low-frequency work. Default fets and operational amplifiers are provided.

The main menu has additions to list current components and issue system commands. All circuits entered or modified are automatically saved, with file overwrite warnings. Components can be entered in Basic compatible or engineering format (eg 4K7, 0.0047M or M0047 all mean 4700 ohms), with comma, space or return delimiting.

The analysis procedure is generally similar to ANALYSER I, but there is no resident frequency list. You can choose an unattended automatic printout, in which case the results first appear on screen (unpaged), after which the circuit details and results are printed.

Next comes an 80-column mode screen graph, using symbol printing rather than plotting techniques, followed by a similar printer plot. Graph printing is quite sophisticated and will provide between 25 and 50 points, interpolated if necessary according to the number of points actually calculated, (these are always included). At least three points must be calculated to get a graph at all.

Allowance is made for the fact that the horizontal rows of dots marking the frequencies are printed by the bottom wire in the printhead while the symbols for the parameter values are centred higher up the head. The correction is made by recalculating the frequencies so that the two positions are in the correct relation, thus *all* the points are strictly speaking interpolated.

In practice the effect is only noticed if the x-axis parameter is changing rapidly. X-axes are chosen to give scale factors in multiples of 1, 2 or 5, while making the best use of the paper width. Exact frequencies are printed down the Y-axis. To avoid phase curve wrap-around you can choose from the overall ranges −180 to +180, 0 to +360 or −360 to 0 degrees. You can also choose to print and/or plot on demand rather than automatically — in either case you can enter a line of comment which will be printed above both results and graph. "You'd better believe it!" or "Oh hell! — it's one of those days!" come to mind as possibles.

Although the screen and printer graphs cannot be as good as a MODE 0 plot, subsequently dumped by machine code, the method used is a lot faster, and quite adequate for most requirements.

CONCLUSIONS

These software items reflect the fact that they were designed by practical people who make serious use of them. Both are flexible, yet require the absolute minimum of effort to use. While ANALYSER II is the obvious choice for R & D circuit engineers, ANALYSER I will suffice for many small firms with occasional design requirements, and for some other disciplines, particularly mechanical engineers, who sometimes work in terms of electrical analogues.

ANALYSER I is also worth considering by those not involved in electronic design, but who just want to discover how some circuits behave. Both versions have many important applications in education. I can thoroughly recommend both — in terms of time, ruined components and sheer hassle they will pay for themselves fast and frequently.

APPENDIX

There is insufficient space to offer a complete guide to computer analysis here, but further outline information will be found in "Circuit analysis by small computer" by A. S. Beasley, *Wireless World* February 1980 (p.39) and April 1980 (p.55). While an experienced engineer will make considerable intuitive use of circuit theorems and mathematical short-cuts when analysing a circuit, this is not possible in a computer program which must use universally applicable, routine methods.

Nodal analysis is the norm, based on the application of Kirchhoff's Laws. Using these we can write various sets of equations in terms of the circuit parameters and the signal frequency, any of which describes the circuit unambiguously, and can be written in matrix form.

The most useful set for our purpose is the indefinite (or "floating") admittance matrix. "Indefinite" merely means that the whole circuit is considered to be isolated from some arbitrary reference point from which all node voltages are measured.

This matrix can be written very easily by inspection, the term Y(1,1) being simply the sum of all the admittances of which one end is connected to node number 1, while the term Y(1,2) is minus the sum of all admittances connected between nodes 1 and 2, and so on.

If there are n nodes the matrix is of order n, with n rows and n columns, representing n independent circuit equations. Because admittance is a complex quantity by definition, two separate matrices are used in practice for convenience, containing the real part (conductance) and the imaginary part (susceptance) of each admittance respectively.

These are derived from the original component matrices after dividing or multiplying the terms, as appropriate, by 2 * PI * f, where f is the frequency. At this stage the indefinite admittance matrix ¦Y¦ is of the form:

$$
\begin{vmatrix} G(0,0) & G(0,1) \ldots G(0,n) \\ G(1,0) & G(1,1) \ldots G(1,n) \\ G(1,0) & G(1,1) \ldots G(1,n) \\ G(1,0) & G(1,1) \ldots G(1,n) \\ G(n,0) & G(n,1) \ldots G(n,n) \end{vmatrix} + j \begin{vmatrix} B(0,0) & B(0,1) \ldots B(0,n) \\ B(1,0) & B(1,1) \ldots B(1,n) \\ B(1,0) & B(1,1) \ldots B(1,n) \\ B(1,0) & B(1,1) \ldots B(1,n) \\ B(n,0) & B(n,1) \ldots B(n,n) \end{vmatrix}
$$

The next operation is to reduce this mathematically to its 2 × 2 equivalent, which represents a simplified four-terminal circuit with exactly the same electrical properties as the one we started with. Provided that the input, output and common nodes have fixed numbers (see main review) this reduction is easily done by means of three FOR . . . NEXT loops, giving a 2 × 2 matrix similar to that above except in order.

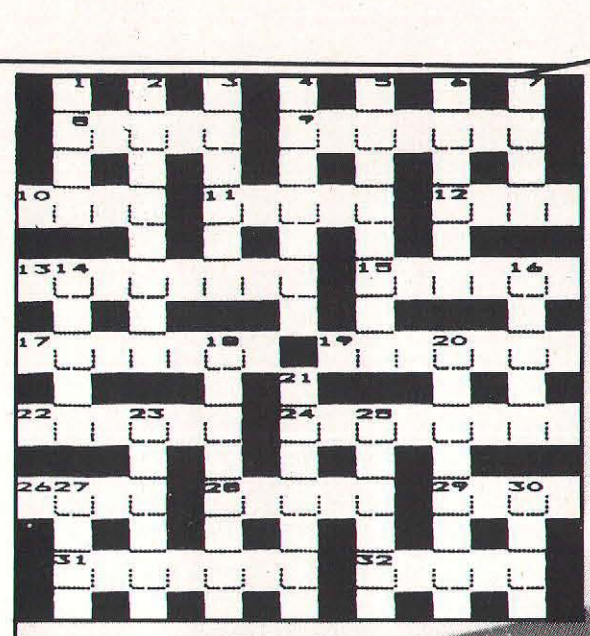
From this "two-port" Y matrix we can obtain the required parameters (gain, etc) using straightforward, well-known equations. The results will be in the general form a + jb, whence, (taking gain as an example) the gain modulus and phase angle are given respectively, by

¦G¦ = SQR(a * + b *b)
and 0 = ARCTAN(b/a)

The whole process must be repeated for each frequency, a new indefinite matrix being set up from the component matrices, and two calculations per frequency are required to give group delay. The need to optimise the program for speed is obvious.

Beebword

Eddie James



CLUES ACROSS

8, 13, 24 Initially easy — but not aimed at the hobbyist (5,8,8)

9 Long to embrace a princess? Here's a welcome message (7)

10 COLOUR A inside statement (4)

11 DFS command associated with PLOT? (5)

12 Basic facility, a car (4)

13 (see 8 across)

15 Acorn dealership? Any GCE result gets you one! (6)

17 VDU 19 affects it (7)

19 *Little Professor* out in December — routine start (7)

22 Select this command from MODE, LET, EXP (6)

24 (see 8 across)

26 Half a panda and its head for this component! (4)

28 Direction to typists: print an ASCII file (5)

29 Sounds like a symbol used in geometry (4)

31 Key the exasperated programmer may lose? (7)

32 Think it's great man, this figure! (5)

CLUES DOWN

1 Hotel employee's variable address (4)

2 It enables text editing in wide rows, perhaps (8)

3 DFS command cooks French bean! (6)

4 Figure it takes 3/8 of Electron to hold version of LISP (7)

5 Read "A" — but change transfer speed (4,4)

6 π + speed — not appreciated by software houses (6)

7 Apparently give birth to a function (4)

14 Consumption of University business software (5)

16 Finish with file on cricketer? (5)

18 Acorn product type: method of ordering data (4,4)

20 Plugs in switches round pole(+) (4,4)

21 Moves screen display — handy for ancient readers (7)

23 Don't contract to get add-ons (6)

25 Girl's name produced by SOUND statements? (6)

27 Cut up rough, as code-breakers do? (4)

30 Error: name too silly! (2,2)

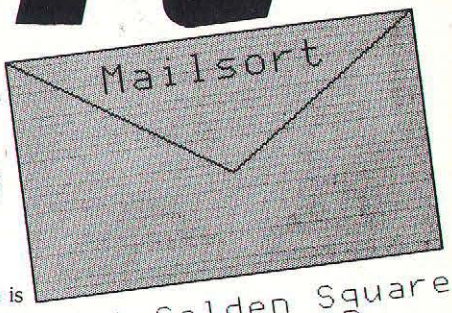
SOLUTIONS ACROSS

8 ACORN 9 LOADING 10 READ 11 BUILD 12 AUTO 13 BUSINESS 15 AGENCY 17 PALETTE 19 DEFPROC 22 DELETE 24 COMPUTER 26 CHIP 28 SPOOL 29 SINE 31 CONTROL 32 DIGIT

SOLUTIONS DOWN

1 PAGE 2 WORDWISE 3 ENABLE 4 ELLIPSE 5 BAUD RATE 6 PIRATE 7 BGET 14 USAGE 16 CLOSE 18 TREE SORT 20 PLUS SIGN 21 SCROLLS 23 EXPAND 25 MELODY 27 HACK 30 NO TO

Mailsort



Readers to the rescue with function key codes and FilePlan problems.

Dear Sir
Readers may be interested in a new command which I have discovered in BASIC II, which does not appear to be listed in any manual to date. The command in question has the form OSCLI (string). It is used to execute any '*' command from within BASIC, the difference being that OSCLI A$ is a valid command. This allows operating system calls to be made while a BASIC program is running eg to allow a user of a BASIC program to select the flash rates of colours. Program one illustrates this.

The value of the token for this command is &FF or 255, and the minimum abbreviation is OS.
Neil Horton
Sutton Surrey

*OSCLI is certainly a very useful command indeed and well loved by programmers for implementing operating system functions like *SAVE which, unlike OSCLI, cannot employ variables from your program. Thanks to Neil for this flashinating example!*

```
   10MODE 2
   20FOR I%=8 TO 16
   30COLOUR I%:PRINT
"X";
   40NEXT
   50COLOUR 7
   60PRINT:PRINT
   70PROCflash
   90END
  100DEFPROCflash
  110INPUT "Enter ON
 Time For"'"First Co
lour"'"In 1/50 Sec."
A
  120INPUT "Enter ON
 Time For"'"Second C
olour"'"In 1/50 Sec.
"B
  130 OSCLI "FX9,"+S
TR$(A):OSCLI"FX10,"+
STR$(B)
  140ENDPROC
```

Program One

A flashinating program

Dear Editor
I am writing to you in the hope that you may be able to assist me. I am the owner of a BBC B with single 40 track disc drive and a Cosmos 80 printer. I also have View installed.

I am a District Manager for a window company and I use my computer to assist me in the running of my team, ie I record names, addresses, phone numbers, contract values etc for all the members of the team, and a separate file for my own customers.

I am at present using the program Database that came with the computer but this is very slow when I am only adding one record at a time. I have to load the whole of my file, which is about 150 entries, just to add one record. This seems to take ages even with the disc drive. I wonder if you can recommend a system which would meet the requirements listed below, which is ROM based so that I can save any information on to any disc, which would appear to be much faster to load.

1 Storage of name, address, telephone no, contract value etc.
2 The ability to access the file for additions or deletions.
3 The ability to print a mailing list.
4 The ability to add a customer's name to a standard letter to save writing each name in by hand.

I am sure with your experience that you probably know better than I do exactly what is required. Cost within limits is not an important factor in this matter.
Thanking you in anticipation.
T.B.W. Jeremiah
Felixstowe
Suffolk

A common problem, Mr Jeremiah, how to configure your BBC for best business results. If you think that it is worth it then the Z80 option may be for you. The "Plan" packages which come bundled with the Acorn Z80 would do all you seem to require. A cheaper option based around your current system (although the single 40 track drive is going to restrict your ability to expand at all) is to purchase a fairly quick access to individual records for output and update.

Acornsoft's Database is ideal but other options include Cardiff's database and Clares' Betabase. Both Database and Betabase have the ability to integrate with View and thus provide names and addresses for wordprocessed letters. Try and get some "hands on" experience before you buy. Unfortunately it is difficult to recommend a ROM based system for your current hardware but if you do intend to expand your storage capacity, Stardatabase is the number one contender alongside Merlin's database. This latter product is best used with the Merlin Scribe wordprocessor.

Dear Editor
Here is a list of useful locations for DFS 0.90:

&F05	Holds the number of files on the disc * 8.
&10CB	Holds the current drive.
&10CC	Holds the current library directory.
&10CD	Holds the current library drive.
&10CA	Holds the current directory.

Note that the full syntax for *DIR & *LIB is:

DIR :drv.directory
LIB :drv.directory

Sometimes the syntax the DFS tells you for commands is incorrect! If you type:

*RENAME fred

where fred is a file on the disc, instead of getting the correct syntax for RENAME, the drive whirrs and Syntax: (afsp) is printed. Also the syntax given for DRIVE seems to imply that the drive parameter is optional. This is not so. Other versions of the DFS may have been corrected, but I haven't tried them.

To finish tidily at the end of a program, insert the following commands somewhere:

```
*FX 200,3
CALL !&FFFC AND &FFFF
```

(For lazy typists, the above line may be replaced with CALL!-4.)

The FX command clears out the memory when break is pressed, and the CALL is to the reset routine whose address is held in ROM at &FFFC and &FFFD.

To change the shape of the cursor, experiment with VDU23; 10,n;0;0;0; where n is 0 to &FF. For instance setting n to 96 gives a slow flashing block cursor in Mode 7.

Some addresses used in BASIC are:

&0,1	LOMEM
&2,3	Top of variables
%4,5	Pointer to free area in BASIC's stack
&6,7	HIMEM
&12,13	TOP
&18	PAGE
&4B,C	Seems to be location of the current variable.

Note that page & OSHWM are two independent values. Changing PAGE will not change OSHWM. I mention this because if PAGE and OSHWM are set differently, exploded characters will reside at OSHWM onwards. As basic has no service entry, it is not informed of changes to OSHWM and so watch out when using ex-

CONTINUED OVER

```
>L.406,407
  406PRINT"11.Print catalogue."
  407PRINT"12.Disc/Tape Catalogue."
>
>
>
>
>L.450
  450IF ANSWER<1 OR ANSWER>12 THEN PROCredo:GOTO290
>
>
>
>
>L.546,547
  546IF ANSWER=11 THEN PROCprinter:GOTO290
  547IF ANSWER=12 THEN PROCcat:GOTO290
>
>
>
>
>L.5500,5530
 5500DEFPROCcat:CLS:PRINTCOL$;"CATALOGUE OF FILES ON DISC/TAPE":VDU10
 5510*CAT
 5520PRINT'"< PRESS RETURN >":ANSWER=GET:IF ANSWER<>13 THEN5520
 5530ENDPROC
>
>
>
>
>L.6000,6130
 6000DEFPROCprinter:CLS:PROCnumrec
 6010PRINTCOL$;"CATALOGUE TO PRINTER":VDU10
 6020INPUT'"Print from which record no., (enter 0   for all)";n1
 6030IF n1>NUMREC THEN ENDPROC
 6040IF n1<1 n1=1:n2=NUMREC:GOTO6070
 6050INPUT'"To which record no.";n2
 6060IF n2>NUMREC OR n2<n1 THEN ENDPROC
 6070IF n2=n1 PRINT'"Send record ";n1;" to printer Y/N ";:GOTO6090
 6080PRINT'"Send records ";n1;" to ";n2;" to printer Y/N ";
 6090INPUTQ$:IF Q$<>"Y" THEN ENDPROC
 6100VDU2:n1=n1-1:N=n1:NUMREC1=n1:N2=n1:N1=n1
 6110REPEAT:N=N+1:N2=N2+1:NUMREC1=NUMREC1+1:PRINT"CATALOGUE No. ";NUMREC1
 6120FORN1=1TO NUMFEL:PRINTFELNAME$(N1);" ";ENTRY$(N2,N1)
 6130NEXT N1:UNTIL N=n2:VDU3:ENDPROC
```

ploded characters!

I hope this has been or will be of some use to someone.

Simon Spruzen
Woburn Sands
Milton Keynes

Interesting stuff for all addicts of Random Access. Those of you who have made use of our Super Disc Menu will already be in the picture. Mailsort just loves interesting memory locations and handy programming hints so why not drop us a line with your particular favourite.

Dear Editor

I enclose two further amendments (see Program two) to the CATALOGUE2 program listed in the July/August 1983 edition with further amendments in the March/April 1984 edition.

This is a very useful program but I felt that in many instances a printout would be an asset and therefore added PROCprinter. A second addition PROCcat allows access to the disc/tape catalogue from within the program, both PROCs being called from and returned to MENU as in the original program.

PROCprinter allows either the whole of the catalogue to be printed out by entering 0 (zero) to the prompt at line 6020, a section by entering the appropriate Records numbers to the two prompts at lines 6020 and 6050 or one Record by entering the same number to both prompts. An opportunity occurs at line 6070 to abort the printer operation in the event of incorrect data being entered with a return to MENU.

PROCcat allows examination of the FILES/DATA on disc/tape and simply uses the *CAT command from the MENU.

These extra commands are added to the program MENU at lines 406 and 407, the error trapping in line 450 is changed to accommodate the 12 choices and lines 546, 547 to accept the keyboard input.

These extra additions means that working space is at a premium especially if a disc drive is fitted. Typical program lengths are as follows:

10787 bytes original program
12246 bytes with March/April additions
13054 bytes with all additions

However, I produced a working program of 11102 bytes, only slightly more than the original program by compacting it, removing all REMs, spaces, by making multi-statement lines where appropriate and deleting the redundant line numbers. This is obviously more difficult to read but I keep a full version as a backup copy. When compacting the lines one should beware and do one section at a time then run it as BBC BASIC appears at times to make some unexpected decisions.

N.L. Smith
Stoke-on-Trent
Staffordshire

Dear Editor

First of all I think the magazine represents good value for money and I take a special interest in the hardware reviews which you do. Keep up these reviews please.

In reply to your question during the Frak review here is what happens as far as I have managed to date.

screen no.	description
1 to 3	Normal
4 to 6	As 1-3 but upside down
7 to 9	As 1-3 but in black/white
10 to 12	As 7-9 but upside down
13 to 15	As 1-3 but black background
16 to 18	As 13-15 but upside down
19 to 21	All shapes with white outlines (like ghosts)
22 to 24	As 19-21 but upside down

Basically the layouts stay the same in the first 24 screens with only the foreground/background colours being changed every six screen. There is however one major failing in the program besides the collision detector.

After screen 19 you get up to five balloons/daggers moving at once which slows the entire screen down considerably, causing key response to be cut in half. One more point the daggers/balloons may come closer without killing you if you are climbing up/down a ladder.

My personal hi-score is: 294,350 (EBG) — could you tell

me what these three letters are for.
PS — If anyone has got onto screen 25 perhaps they would drop me a line and tell me what it's like.
Michael Shaw
Hastenbeck School
West Germany

Dear Editor
I read with great interest your review on the ULTRADRIVE in A&B Computing, October issue. I had already decided to purchase one of these drives after my holiday, having read two articles in other publications. I think your review made it pretty obvious that the others had not really used the drive for any period of time as not one came up with any problems as you have.

I will still purchase the drive but at least I know to expect a few pitfalls and from what you say these can be overcome with some thought.

You mention a couple of short programs you have written to overcome some of the problems. Are you willing to let me have copies of these or will you be printing them in A&B future issues? I have not had my computer long and don't really know enough about writing programs to do these myself. I would be grateful if you could advise me of any other problems you have encountered with the drive.

I thank you for your help and again may I say how much I enjoyed reading a really truthful and informative review.
Neil Mcpherson
Harrow
Middlesex

A&B won't need to publish Jonathan Evans' undoubtedly excellent programs since Ikon have successfully updated their software to perform the necessary functions after the review was published. What we did miss from that review was a contact address for Ikon. We wish we hadn't, considering how many of you phoned up to find out! Here it is: Ikon Computer Products, Kiln Lane, Laugharne, Carmarthen, Dyfed. SA33 4QE. Telephone 099 421 515.

Dear Editor
I am an Electron user and an A&B Computing reader. Recently I have been using a SIR computers Printer/ADC board and their ROM/RAM extension board with a standard Acornsoft VIEW ROM and have been very pleased with the performance. Despite the lack of the BBC's 'red' keys I have found that the use of the CAPS LK key plus the use of ordinary letter keys can simulate all of the functions. It is not, I am sure, coincidental that the functions on the BBC, using the function keys plus CTRL or SHIFT keys are in alphabetical sequence on the Electron!

Below I list my findings. You will notice that there are a couple of question marks, as I cannot find a use for these, though time may rectify this matter.

The BBC has 19 'red' keys and as there are 26 letters in the alphabet there is scope for more functions and the use of keys L,M and N (after the A to J, which are the BBC's SHIFT 'red' keys) provide for other functions that differ on the Electron. The keys Q to Y correspond to the BBC's CTRL 'red' keys.

Lastly, could you tell me if the 'E-PRINT' program, published in the July/August edition, will run on an Electron with a VIEW ROM, as I use an Epson RX-80 printer and would like to explore full range.
John F. Vickers
Leighton Buzzard
Bedfordshire

Thanks to Mr Vickers for enlightening us about View and the Electron. It should be pointed out that View is now available as a cartridge for the Electron Plus One and can form the basis of a very handy wordprocessing system with Plus Three discs in tow. You can also add Viewsheet on cartridge and Database on disc for a complete office system.

Text Mode Commands

Commands using 'CAPS LK'

KEY A — MOVE BLOCK
KEY B — SWAP CASE
KEY C — RELEASE MARGIN
KEY D — DELETE UP TO CHARACTER
KEY E — HIGHLIGHT 1
KEY F — HIGHLIGHT 2
KEY G — SET MARKER
KEY H — GO TO MARKER
KEY I — EDIT COMMAND ON ('RETURN' ENDS EDIT)
KEY J — DELETE COMMAND
KEY L — RULER (CURRENT)
KEY M — MOVES CURSOR FORWARD WORD BY WORD
KEY N — MOVES CURSOR BACK WORD BY WORD
KEY O — ?
KEY P — ?
KEY Q — DELETE BLOCK
KEY R — NEXT MATCH
KEY S — FORMAT MODE
KEY T — JUSTIFY MODE
KEY U — INSERT MODE
KEY V — DEFAULT RULER
KEY W — SPLIT LINE
KEY X — CONCATENATE LINES
KEY Y — MARK AS RULER
KEY Z — ?

Commands using 'CTRL'

TAB — CTRL + I
YELLOW TEXT — CTRL + S (HOLD FOR A SECOND)

Dear Editor
Regarding page 77 of your May/June issue (Questions and Answers), "Bad String" is issued as an error message if you try to LOAD or SAVE a program or file using a filename of more than 10 characters. It is also given if you try to SAVE a program with a null string as a filename. As well as an illegal key number, "Bad Key" is given if there is not enough memory on page &B to hold your key definitions.
Best wishes
Ben Craig

Dear Editor
As a relative newcomer to the computer world I am still at the stage of enjoyment through game playing. I am being frustrated by "Kingdom of Hamil". I have solved many of the obstacles but was eventually forced to open the envelope. Clues/hints to the rescue but where (close your eyes at this point if you don't want to spoil your own fun) is the fish room? And what does one do to make one's breath foul enough to pass the enchantress? And where is the vault? I am beginning to believe that the answers do not exist.
G. Dunkley

Can any of our adventure readers lend a hand? We don't want Mr Dunkley to lose faith now do we? Adventure help and hazards to our Golden Square address please.

Dear Editor
We are in the process of establishing a database of software for the handicapped — BARDSOFT. Briefly, each entry to the database will contain a description of the programs, the handicaps they are suitable for, the type of computer system required, name and address of supplier/developer and price etc. This information will be made available through printouts in answer to specific enquiries.

The aim of BARDSOFT will be to facilitate the exchange of information on software relevant to any aspect of the lives of han-

CONTINUED OVER

dicapped people. One major addition will be the concerted effort to promote the database, and therefore the software, abroad. This is what we have been doing successfully for non-software products in the field.

As we are currently collecting and processing information, we would be pleased to hear from any of your readership who may wish to contribute to BARDSOFT. For further information please contact me.
Peter Curran

A worthy cause indeed. I know that A&B readers will want to help. Here's the contact address: Peter Curran, Handicapped Persons Research Unit, Newcastle Upon Tyne Polytechnic, No. 1 Coach Lane, Coach Lane Campus, Newcastle Upon Tyne NE7 7TW. Telephone 0632 664061.

Dear Editor
I feel I must reply to certain points made about the McVid Software by your reviewer in "Programmers Paradise" in the October issue of A&B.

Firstly, out of all the McVid packages that have been sold, the only loading problems that have been brought to our notice, apart from the reviewer's, have been caused by the old BBC chestnut of certain ROMs moving PAGE too high for the Demo to run. (Incidentally, this problem can be quickly overcome by typing PAGE=&1900 before loading the Demo). Also, the Demo on the reviewer's tape had already been successfully loaded and run by a member of your editorial staff.

Secondly, I refute the criticism that one of the Demo listings is not described.

Thirdly, I would like to thank the reviewer for drawing everyone's attention to a small bug that unexpectedly crept into the Mode 4 & 5 Right Screen Scrolling Routines; pICa apologises to customers for this error and will be happy to replace their McVid free of charge. Alternatively, those wishing to amend the routines themselves are advised to do the following:

*** LOAD MODE5**
?&547E = &28
*** SAVE MODE5 5200 57FF**

The same procedure should be used to correct the MODE 4 routine.

Disk users should *ACCESS MODE5 before *SAVEing.

Fourthly, the reviewer was quite correct in stating that the routines were designed to be used primarily by machine code programmers. However, I do not see what is 'odd' about this approach even though the routines can be accessed from BASIC. Many machine code programmers are prevented, either by a shortage of time or a lack of experience, from developing their own line drawing, shape rotation and scaling routines totally in machine code. Therefore I reject the reviewer's argument "that anyone experienced enough to understand it (the manual), probably won't need the routines".

Furthermore, the source Listings could not be supplied on the tape/disk because they take up over 100K in total. The Source Codes for Modes 0, 1, 2, & 4 can be supplied to anyone with access to a text editor at a charge of £5 per disc or cassette.

Finally, I am pleased to be able to announce that a character/line definer will soon be included as part of the McVid package. Anyone who has already purchased McVid and would like a character/line definer is invited to contact pICa Software at the address below.
Jim Gray
Pica Software
Pro-Supply Ltd
4 Beech Court
Pocklington
York

P.S. I am glad to see that you have gone monthly, as I still feel that your magazine is one of the best.

Dear Editor
I am an Electron user and read your publication, A&B Computing, avidly. I have tried without success to get your Backgammon program in November 1984 to work correctly but have trouble moving the game cursor. Can you help?
Michael Hilbig
Manchester

Yes we can, Michael. The crucial lines are 210 and 240. The values −114 and −33 represent the function f0 and f1 keys on the BBC but not on the Electron. The best thing to do is to change these values to known negative INKEY values, as listed on page 159 of your Electron User Guide. Might I suggest those well known games keys Z (−98) and X (−67) for forward and back and perhaps the cursor keys (−26 and −122), all of which incidentally are identical on BBC and Electror.

Dear Editor
It may be of interest to fellow Beeb owners that Acornsoft have taken the view that all disc drive owners use only the Acorn DFS in their marketing strategy for the excellent game Elite.

I and many others like to match the excellence of the Beeb with the best that is available in support systems and have bought a DFS that gives better facilities than the Acorn product — in my case Watford's DFS. Unfortunately, the disc version of Elite does not run under Watford DFS, nor, I believe, under Pace's.

On phoning Acornsoft, I received only the advice that the game had been written with the Acorn DFS in mind, not other DFSs. I asked whether it was not felt that some hint of this parochial view would be a good idea in the advertising copy of Elite, but this did not go down at all well!

In my view Acorn are going to lose out. Given a choice of a good game or a good DFS, the latter takes preference. If game sales are to be maximised, all Acornsoft have to do is to be a little less clever in their programming routines — we could all then enjoy the game as well as our choice of DFS.

I hope that this letter serves as a warning to any budding Elite owners — your dealer may not be as sympathetic as mine, and £17.95 is a lot to waste!
B.G. Hulatt
Sunbury-on-Thames
Middlesex

It does seem, I am afraid, that at least some disc versions of Elite depend on there being an 8271 in your machine (or an 8271 emualtion!). The latest version however appears to work with the Opus double density filing system, not 8271 based. Best to check with your dealer first and of course, if it doesn't work, don't be afraid to take it back for a refund.

Dear Editor
We have recently changed both the venues of our meetings and the names of the contacts. I would therefore be grateful if you could make a note of current information.

The West Surrey Computer Club meets on the second Thursday of the month at the Stoke Hotel, Guildford.

We also have a BBC User Group which meets on the 3rd Friday of the month at the Guildford County College of Technology.

Guest speakers at Stoke Hotel give illustrated talks on a wide variety of topics over the year to cater for all interests and abilities. Members also bring their systems to meetings.

The BBC User meetings are more informal and provide a useful opportunity for the exchange of ideas on this machine. A newsletter, Format, is published quarterly.
(Mr) Jan Spencer
Guildford
Surrey

Thanks to West Surrey Computer Club for the information. Any computer clubs are welcome to get in touch with forthcoming events which they would like to publicise but remember that the magazine is put together some month and a half before its publication date on the first Friday of the month preceding the cover date.

Language Lab

Clive Grace

BBC Micro speaks with Forth tongue. HCCS and Computerphile versions reviewed.

Forth is one of those langauges which it seems will never die. In the light of highly structured languages with compilers, and easy Algol based syntax the older languages would, it seems, be ousted by brash youngsters eager for use in an industry which thrives on change . . . . all except Forth. Forth's survival has been something of a surprise to many people. It still has a healthy following among users in technical and engineering fields and its success amongst professional users appears to be moving over to the enthusiastic home user as well.

ADVANTAGES

Forth has many advantages over BASIC in that it is very fast and compact, and allows the user to access features of a machine which would have been impossible elsewhere other than Assembler. Instead of being fully compiled into the machine's native processor, it is compacted and optimised into a "Threaded Interpretative Code" (TIC) which essentially means a string of machine code routines linked by pointers in Forth to execute when they are called. This is very very compact and although not pure machine code, it has speed advantages. Its major disadvantage is that it takes some time to get used to the cryptic error messages, the stack orientation which works in reverse polish, and an unfriendly editor, for those unfamiliar with the system. I once noticed the look of horror on one youngster's face when he saw a Forth listing for the first time. It is so unlike any other language that it forces the user to reconsider many logical problems, which is sometimes a good thing.

Briefly, Forth relies on a stack to store numbers for all operations. Forth's stack can be thought of in real terms as a stack of plates, each plate representing an area of data, the last plate put on the stack will hold the most recent item. This is a LIFO stack meaning "Last in First out". So an operation to add two numbers would require two numbers to be stored on the stack before it is acted upon — so to perform a simple ADD we would:

2 3 ADD (Press RETURN)
OK

but unlike most languages we do not output any result on the screen. What we have in fact done is to take the top two numbers and ADD them together, and then delete the last two stack entries and store the result on the stack!! and if you remember the stack of plates analogy, the result must be on the top.

That is essentially how Forth stores data items and values in memory. Programming languages like Pascal and BASIC clearly make these operations invisible to the user. They do them automatically in the system's housekeeping tasks. They control pointers and make sure that the stack doesn't overflow, but these all slow down the languages and are also strongly tied in with how each user's computer accesses internal memory. These standards are much more rigidly enforced in Forth than any other language next to assembler.

The stack we were working with to begin with was the *computation* stack. The second type is not accessible from any language other than Forth and Assembler and this is called the *RETURN* stack. This stores all the addresses of valid 6502 instruction codes and branches and labels as well as data put there with instructions.

Due to its compactness HCCS Forth is good at writing utilities which are fast and reliable. Control systems find that Forth is excellent at reading data in from I/O lines and makes a good interface with the outside world. Laboratories need a lot of surveillance equipment to oversee and record certain aspects of an experiment while the technician is otherwise occupied. Monitoring the temperature is always a critical factor in most experiments as well as monitoring the speed at which two chemicals are mixed. Forth has been used to control and monitor experiments in industry and in many cases it offers a cost effective solution, providing someone is willing to do the programming involved — this example can be brought down to the home user. A good example involves a Forth dedicated machine running a train set.

There are so many implementations of Forth around on the BBC micro that an update of HCCS Forth (reviewed in the November 1983 issue of ***A&B***) has surfaced, totally re-written to work on Econet and the 6502 Second Processor as well as an ordinary unexpanded Beeb. The changes are significant enough to allow a second look. Another new compiler is Split-FORTH which not only compiles into the TIC code but also into stand alone machine code.

HCCS FORTH

It is unusual to review an update of a language as normally the "improvements" made are either cosmetic or they should have been done in the first place. However version 2.6 of this already popular compiler has been totally re-written and it is a pleasure to have a second look.

Essentially HCCS have realised that the 6502 Second Processor is going to find a lot of serious users in control and applications software. To give the programmer a choice (over Hi-Basic and Assembler) HCCS have made the ROM Second Processor compatible, extending the internally compiled code to a massive 30K+ and allowing for a 50% speed increase as per non Second Processor Forth execution speeds. Version 2.6 is standard Forth 79 and includes extensions for the BBC's sound and graphics facilities. Operating system calls are included and are vectored to allow many different filing systems to be present such as Econet and DFS, as well as memory expansions such as the Aries Board and of course the 6502 Second Processor.

The revised package includes an EPROM, a Libraries Disc and a large, weighty manual. I cannot comment on what the packaging will look like as I was working from pre-release material but I can assume it will be in typical HCCS style which is rugged and compact. If the user has no disc system then the Forth ROM will behave in much the same way as version 2.5, the only immediate difference being operating system calls using MON are now changed to MON" and are enclosed in double quotes. Disc systems are easier to work with as Forth may store both ASCII files and compiled code in memory at the same time. Using the disc system requires quite a bit of disc accesses in program development but this does not slow the system down at all.

LIBRARY DISC FILES

Included for disc users is a Libraries disc which allows the user to !BOOT into the operating system, the files are thus organised as to be easily tailored to suit the user's configuration. DFS or Econet are both supported and the system files may be used with most of the "Acorn Compatible" Disc filing systems. Fig 1 shows the catalogued disc.

The first Files are typical Forth screens 003 to 010 which constitutes the source code for the filing system and " * " commands in default OSFILE form, that is calls to the DFS need not be passed through the MOS via the MON" command anymore. It also allows the user to modify the filing system very easily to suit his own specifi-

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cations.

Files DFS.E, DFS.16, 16.LINK are all files which set the dictionary pointers for Econet only, DFS.D, DFS.1D, 1D.LINK likewise configure the system for use in a DFS only system. Tailoring is easily done using * BUILD to create a !BOOT file for immediate loading whenever Shift BREAK is pressed.

Some special files have been included to aid the user in general management of the system and to help programming. They include $BSRT.F which allows the user to bubble sort any ASCII data as well as NBSRT.F which does the same for numeric data. EMSG.F gives full error messages in text and CASE.F gives Forth CASE constructs. SNCOS.F gives Forth the ability to work using sines and cosines and BUGGY.F includes files which are needed to drive the Economatics BBC Buggy. O NEW.F and COPY.F are source screens used by the operating system. Finally, V2.6 includes the standard Forth Assembler.

The manual has been totally rewritten to accommodate both Tape and Disc users. The style is informative and well laid out and is easy to read. The typeface is clear and stands out well. The manual takes the user through the stages of learning the system (remember "Hello World"?) and then describing Forth's features, the manual makes easy reading for the experienced and Forth literate and is compulsive reading for those who are not, making the style chatty and nowhere patronising. It is however very very big (almost as thick as the BBC User Guide) so be prepared to sit up some night reading this weighty tome.

The Forth dictionary is discussed and each command is covered in a paragraph, giving ample descriptions and examples to illustrate a point. It manages to summarise many features in a way which makes it easy to refer back to, this occupies about half of the manual. The Buggy is also given a great deal of interest and the listings are included in the manual with full documentation to drive it in turtle style, controlling the movement in eight directions as well as the Logo commands PENUP and PENDOWN.

THE EDITOR

Forth's editor is not the nicest of editors to get along with. In 1968 when Charles H. Moore wrote the first Forth compiler to drive machinery like Radio Telescopes by computer, VDU screens and online processing were rarely found in all but the most modern systems. Instead programming was done on teletypes which allowed the user to simply look back on a listing in order to see an error or a certain piece of program. The problem is that the commands are all single letters and are all invoked by the EDITOR command which to the experienced is simple and fast. But those learning it may consider Microsoft's BASIC editor to be better!

A Forth program is not like other languages in that it is not one single file but many small 1K files. These are given numbers and are loaded in, compiled and then the next sequentially numbered file is compiled. So a program may consist of files 040 to 050 meaning that one program occupies 10 screens each loaded in, then compiled — this has the advantage of making it easy to spot mistakes in a Forth program because each section can occupy one or more screens and makes general debugging easier. Imagine a procedure which is its own little program and you'll see what I mean.

One starts programming by issuing the command PROGRAM which is duly followed by the "What Screen Number" query, any number between 0 and 9999 is acceptable for cassette users.

For disc users, a slightly different approach is made in that the user creates a file for storing all the screens for a program on disc so screens may be numbered from 0 to 9999 but may be stored in the file PROG1. This means that the user has a far better knowledge of what screen 032 means in file PROG1.F because as filenames may be easily duplicated in Forth screens can go missing in no time at all.

CREATING A DISC FILE

The command "Create-File" sets up a disc ready to write to so a good example would be:

C R E A T E - F I L E
PROG1.F,5,10 (CR)
OK

This sets up the file PROG1.F to store five screens starting at screen 10, we can check this at any point by typing:

FILE: PROG1.F
PROF1.F Contains Screens 10 to 15

If you are editing a screen which already exists the message on a SAVE will read:

FILE: PROG1.F
Delete old Screen? (Y:N)

For additional security the command LOCK will lock the screen to avoid accidental erasure in the same way that * ACCESS *

* L does for a whole file. An example of a Forth screen stored in a file GRAPH.F is shown in Fig 2.

USING FORTH

HCCS Forth is one of the easiest versions I have met in everyday use. Programming is made all the easier by the utilities supplied on the disc, it can be used for a number of applications, such as utilities and fast routines can be easily written. Accessing the potential of machinery around you would be made all the easier in Forth since it is designed to handle fast control robots and machinery in industry. This is very much the classic use of Forth and with the emergence of machines which can handle reasonably complex graphics shapes with accuracy and colour, Forth has seen a number of extensions.

HCCS Forth has always supported graphics well and with the new compiler, some commands have been added to allow graphical shapes to be moved about on the screens. The commands PLOT, DRAW, and PAINT allow shapes to be drawn in the same manner as BASIC's keywords except PAINT which allows the user to fill any shape in any colour quickly in the same manner that PLOT 85 will draw and fill a Triangle. We can fill an irregular polygon with the same ease:

```
Forth V2.6
EDITOR OK
L
SCR # 0
0 : POLY                          (Defined a word called
                                  POLY using :)
1 2 MODE 640 512 DGO              (Mode 2 and sets up
                                  Cursor)
2 -200 -100 MOVE
3 -300 -200 DRAW
4 -500 -200 DRAW
5 -500 0 DRAW
6 -300 0 DRAW
7 -200 -100 DRAW
8 0 1 GCOL 0 0 -200 PAINT         ( GCOL to 1 Polygon)
                                  (Load and compile
                                  screen)
9 —►
10
11
12
12
13
14
15                                ( END OF SCREEN )
```

```
Fig 1: The Catalogued Disc with many utilities.
>*CAT
Single Density          (60)
Drive 0                 Option 3 (EXEC)
Directory :0.$          Library :0.$

    !BOOT                   $BSRT.F
    003                     004
    005                     006
    007                     008
    009                     010
    16.LINK                 1D.LINK
    1F.LINK                 ASMB.F
    BUGGY.F                 CASE.F
    COPY.F                  DFS.16
    DFS.1D                  DFS.1F
    DFS.E                   DFS.ED
    EMSG.F                  FCOPY
    INSERT                  NBSRT.F
    O>NEW                   O>NEW.F
    SDEL                    SNCOS.F
    TNEW
```

Fig. 1

The graphics are fast and clear and represent a significant speed increase over BBC BASIC which is extremely efficient itself. Running across the Tube makes things faster by 50%, probably the fastest I have ever seen Forth running on an 8 bit micro.

Because of Forth's ability to handle characters on the screen so well, it could be ideally suited to writing arcade type games on your home computer quickly and with pleasing results. In fact, many of the older arcade games used to be written in hybrid form called Meta-Forth which allowed the games manufacturer to develop the software, compile the code, and install them on machines in very little time, but it must be stressed that I have hardly ever seen arcade games written in Forth.

SYSTEM DESCRIPTION

HCCS Forth is excellent at control applications because of its internal memory layout. Routines which store a certain value in memory from reading an I/O Bus such as the user port or the RS423 port are freely accessed by storing values in free memory. Because of this arrangement memory allocation is very important, more so with HCCS Forth as most of the Forth operating system is vectored, allowing the user to freely adapt calls and even include operating system patches themselves. This is why the manual takes great pains in describing the system accurately and as clearly as possible.

The BASIC keywords PAGE and HIMEM are called FIRST and LIMIT whilst in FORTH and have the same values, although because of the way FORTH is designed there is no facility to change PAGE and have programs lying about in different addresses as compiled code lurks in the higher reaches of address space.

Zero Page contains many of the code pointers for the Forth system upon language entry. When booted, the operating system allocates memory from the values stored in here. As no user memory is taken up by this system and all O/S calls are vectored these values and pointers may be changed. Page One and upward control most of the system's housekeeping tasks and store the terminal input buffers, so the user can type ahead whilst the machine is otherwise occupied. This clashes with the CPU return stack from &1FF downwards. Address space &400 to &4C9 are all addresses for booting an entry into the Editor for Graphics and the Compiler itself. &800 to FIRST-1 is used by the BBC operating system or by the Tube if fitted.

The user variables may all be read and modified and code offsets from &32 to &78 are all allowed. With this information the internal clock may be read by calling OSWORD with the Accumulator set 1:

```
: TIME 0 0 0 1 SP@ 2+ 0
OSWORD SWAP ROT
DROP;
```

stripping the most significant byte so reading only the four digits displayed on the clock. HCCS FORTH also allows the user to send values to the speech processor if one is fitted by adapting the SOUND word to call the -1 channel so a whole phrase could be stored in a single word, called up at will, making the speech processor easier to use in Forth than in BASIC.

CONCLUSIONS

HCCS FORTH version 2.6 is an extremely well written piece of software, it takes FORTH far beyond its restrictions and brings it into 1985 with features that allow routines and programs to be easily written. Its Second Processor compatibility ensures large systems can be set up with ease.

The Libraries Disc is essential if the user intends to make full use of his system, as it includes Forth source programs which are invaluable even in the early stages of use.

HCCS have obviously taken a great deal of care in improving what was an already excellent system (HCCS FORTH was the first implementation of FORTH in a ROM) and those who are interested in learning FORTH or those with the intention of using a fully blown implementation (such as this one) can be assured of a package that has all the features of a Micro Forth as well as some Mini systems. It is an excellent product and for the serious user it would be safe to assume that HCCS FORTH is assured of a long and healthy life.

MANY CONFIGURATIONS

HCCS have also released similar and compatible versions of the same Forth compiler for other, more specialised purposes. Although Version 2.6 looks to be a very popular version, parallel releases include: a 16K EPROM containing the Assembler and Library in the ROM and includes the 200 page manual at £49.00, a special 'tube only' release which takes advantage of the full 64K addressable memory in the 6502 Second Processor which is disc based and retails at £29.00 plus manual. Finally the reviewed FORTH V2.6 will cost £34.72 including the Libraries Disc and 200 page manual. HCCS are at: 575-583 Durham Road, Engine Lane, Low Fell, Gateshead, Tyne and Wear, NE9 5JJ.

SPLIT-FORTH

A very different product from Computaphile is Split-Forth. It requires a minimum configuration of a single disc drive which is used to load in the main compiler. It is not Second Processor compatible forcing the "This is not a language" message! It is not as professionally packaged as HCCS FORTH but then it is intended to be more "down market" than its competitors, being more interested in the user group side and attracting serious users who are well versed in Forth. It does however support an Assembler and can compile most of Split-Forth into pure stand alone machine code, which will find a great deal of interest amongst people writing utilities and the like.

WHAT YOU GET

The whole Split-Forth package consists of a ROM, a Floppy Disc containing library files, the dictionary and a very thin A4 manual. The overall appearance of the package is strongly reminiscent of old Forths produced by user groups and individuals in the days of the Nascom and Ohio machines. In fact Split-Forth is a reminder of how individuals used to produce software before the high powered and glossy selling techniques of today.

The ROM is fitted in the usual manner and is accessed in the same way as all the other ROMs. A *HELP will in fact include the copyright message which is unusual to find in a language. Upon a booted entry Split-Forth will search the disc drive for the second half of its compiler and initialise itself with the familiar "Ok" message. A sample VLIST will list all the current FORTH words and definitions.

The manual and documentation is adequate although somewhat stark in contrast to other implementations, being only 58 printed pages with no illustrations. The manual is not really suitable for those wishing to use Forth for the first time and I would suggest one of the many

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```
Fig 2 Shows a FORTH screen.

Forth V2.6
EDITOR OK
L
SCR # 57
 0 ( SINE, COSINE DEMO )
 1 GRAPHICS DEFINITION DECIMAL
 2 : TAN DUP SIN SWAP COS -DUP IF 100 SWAP */ ELSE 3 * THEN ;
 3 40 VARIABLE AMPLITUDE 1440 VARIABLE LENGTH
 4 : SINWAVE LENGTH @ 0 DO I I SIN 40 / DRAW 4 +LOOP ;
 5 : COSWAVE LENGTH @ 0 DO I I COS 40 / DRAW 4 +LOOP ;
 6 : TANWAVE LENGTH @ 0 DO I I TAN 40 / DRAW 4 +LOOP ;
 7 : ALLTHREE 0 512 DGO 0 0 MOVE SINWAVE 0 0 MOVE
 8   COSWAVE 0 0 MOVE TANWAVE ;
 9 : CIRCLE2 0 OVER MOVE 364 0 DO DUP I POLAR
10   DRAW 4 +LOOP DROP ;
11 : CIRCLES 400 0 DO I CIRCLE2 10 +LOOP ;
12   0 VARIABLE ANGLE
13 : POLYGON 360 SWAP / ANGLE !  0 OVER MOVE 361 ANGLE @
14   DO DUP I POLAR DRAW ANGLE @ +LOOP DROP ;
15 ;S

 #( SINE, COSINE DEMO )                                  0 OK
```

Fig. 2

Forth teaching books in the bookshops today as a companion guide.

The manual is divided into roughly five sections, introducing the package's basic facilities through an example program which cleverly introduces both FORTH literate and beginner to Split-Forth's programming method which is quite different to HCCS' version in that programs are stored in the classical fashion of screen numbers. The system loads the lower dictionary from disc into the user area from &1100 to an address called DP which is a user variable that sets up the dictionary pointer which informs the system of the next free memory location. Screens four and five are also included (error messages). Consequently screens from 6 to 99 are allowed.

The second section of the manual describes the Forth nucleus and words which are fairly standard, however Computaphile have made adequate use of some of the Beeb's facilities and allow communication to the MOS and DFS by extending the command library. (DISC) is a useful word which is an 11 byte variable array and is able to store vital information such as the current drive in use as well as lo and hi byte storage addresses. And for really advanced disc accessing both the track and sector number are stored as well as disc errors and the like. Communication to the MOS is possible via the '✂ command which will accept any valid call to the MOS. +BUF allows the user to advance disc buffer address to the next, which is again ideally suited for File handling.

A routine which is included as standard in this implementation is .S which displays the stack without destroying the contents of the stack or resetting the stack pointers. This facility is extremely useful when debugging a program and for displaying characters such as teletext characters or advanced graphics in Modes 0 to 5. The words ;VDU and ,VDU are used to transmit double and single bytes to the current output stream, in many cases the screen.

The third section deals with the Split-Forth editor which is very much the ordinary Fig-Forth editor and most of the information is taken directly from the 1980 Fig installation manual and all the eccentricities and quirks are included. The basic commands are;

n H Hold the PAD line
n D Delete line but keep it in PAD
n T Type Line N and store it in PAD
n R Replace line n with contents of PAD
n I Insert text in PAD at line n shoving up a line (line 15 is always lost)
n E Erases line n
n S Places a dummy line at n and shoves rest up (line 15 is again lost)

PAD is an area of the Editor which is exactly what is says. It is a general purpose area for writing program lines for common storage and can be used to store definitions which need to be copied and modified. There are also facilities for string editing as well as screen editing, but for most of the time L (list a screen) and P (put text onto a line) are all that is needed for keyboard entry.

The penultimate chapter gives an in-depth look at the assembler included in Forth which is again the standard assembler for 6502 based Forth machines by William Ragsdale, and supports all single mode opcodes as well as most of the multi-mode opcodes and must be followed by an operand on the stack and can be addressed in a number of methods. Both Accumulator and Immediate addressing modes are supported as well as both Direct and Indirect Indexed X and Y. A good example of FORTH supported assembler is:

.A ROL,	**ROL A**
1#LDY,	**LDY # 1**
addr ,X STA,	**STA addr,X**
addr ,Y CMP,	**CMP addr,Y**
6 X) ADC,	**ADC (6,X)**
pointer)Y STA,	**STA (pointer),Y**
vec) JMP,	**JMP (vec)**

As you can see the stack orientation is still very much a part of Forth's assembler and, once learned, it becomes very very useful indeed for inclusion in many Forth definitions. Although in some aspects it defeats the point of using fast compiled languages, it also has the advantage of being flexible enough to support assembler routines for many applications.

The last section deals with system information as well as a quick reference guide. Some useful utilities occupying screens 48 to 65 are included, primarily taken up by a Logo interpreter and demonstration listing. Included with the package was a listing of a database in Forth which proved to be very good indeed. There are a number of advantages of writing a database in Forth, mainly ones concerned with compactness of code and fully compiled Split-Forth is quite compact. The database can also be tailored for use by the reasonably Forth literate user for just about any application.

CONCLUSIONS

There are some disadvantages to Split-Forth in that it is much smaller than other implementations and supports less features than many older compilers. However it has advantages that, to my mind, outweigh its immediate shortcomings. It has the ability to compile into pure 6502 machine code and execute without the presence of the Forth ROM in many cases, and for the serious user who is interested in writing stand-alone utilities which are fast and compact. This allows the programmer to generate code in a fraction of the time it would have taken in Assembler. Computaphile is an enthusiast's implementation and really isn't suited to the beginner as it has pitfalls open to the unwary. It is possible to crash the system quite easily, which is understandable since Forth's intention is not to place a barrier between the user and his machine but to provide a controlled environment allowing facilities only possible in Assembler to be written and developed with relative ease.

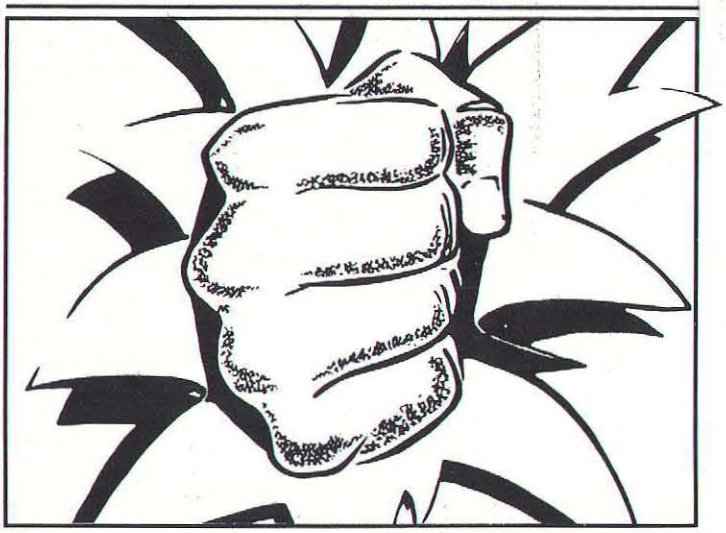
It is also a refreshing reminder that there is still room for the small enthusiast to get a compiler out which is inexpensive and is more or less good value. Which is after all the original intention of Forth's many user groups. Computaphile are interested in setting up a user group around Split-Forth which would ensure a strong user base and lots of software.

Split-Forth costs £23.50 and is available from: Computaphile, 103 Woodchester, Yate, Bristol BS17 4TX.

Cut and Thrust

A. Seed

Challenge a friend or your computer to this fast 'n' furious adaption of a childhood game.



This game is a version of the traditional Scissor — Stone — Paper game adapted for the BBC Computer.

The traditional game is for two players, requiring no more equipment than their two hands. The two players face each other and beat a rhythm with their left hand; the right hand is hidden behind their backs. Simultaneously they bring their right hand to the front with their hands forming a shape to represent either a pair of scissors, a stone or a piece of paper.

For example, the first and second fingers open to represent a pair of scissors; a closed fist to represent a stone and a flat hand to represent paper.

The two players hands are then compared and the following rules are applied:-

Scissor cuts paper; therefore scissors wins.

Paper wraps stone; therefore paper wins.

Stone blunts scissors; therefore stone wins.

Hence each player tries to anticipate the choice of the other by guess work, intuition or *extra sensory perception*.

BBC VERSION

In this version of the Scissor — Stone — Paper game I have tried to include all the essential ingredients of the traditional game — beat a rhythm, anticipate the opponents choice, simultaneous show of choice by means of pictorial representation — a chuckle when you win.

This version has the added advantages that each participant's score is continuously shown and there is a one person version of the game by playing against the BBC Computer. In this case the Beeb makes a random choice of the three alternatives — Scissor, Stone, or Paper.

THE PROGRAM

The programme itself is very short (ending at line 160). The various procedures called, however, occupy all the available memory in Mode 1.

The program details are as follows:-

Line 30	sets up Mode 1.
Line 40 & 50	disable the normal function of the ESCAPE and BREAK keys, so that the programme is RE-RUN from the beginning if these keys are pressed. This serves both to prevent losing the program if these keys were inadvertently pressed and, also, as a means of starting a new game.
Line 60	uses *FX202, 16 code to set the shift lock on.
Lines 70-150	call the following procedures:- G$ = "SCISSOR — STONE — PAPER GAME" S$ = "SCISSOR CUTS PAPER" P$ = "PAPER WRAPS STONE" s$ = "STONE BLUNTS SCISSORS"
PROCintr	This procedure describes the traditional game and rules and also sets up the required sound envelopes and redefines the foreground and background colours.
PROCinstr	This procedure displays the instructions for playing the computer version of the game, including the keys to press, etc.
PROCname	This asks if there are one or two players and directs the programme to PROC one or PROC two. Note that although the SHIFT LOCK is set at Line 60 it may have been inadvertently released and so both the normal and shifted key 1 and 2 are tested. Any other key is ignored.
PROCchar	This sets up the character definition for the picture of the pair of scissors. Using the VDU command the scissors are drawn, using redefined characters, because scissors are a complicated shape and are required to appear very quickly. Characters appear as quickly as ordinary text.
PROCplay	This is the main procedure and is called by the REPEAT-UNTIL loop at lines 120 and 140. PROC One or PROC Two are called at line 1220. These procedures determine which key was pressed in a one or two player game. Lines 1230 to 1310 compare the keys pressed to determine which player won or drew. Depending on this comparison the following procedures are called: PROCdraw, PROCLwin, PROCRwin, PROCLsciss, PROCR sciss, PROCL pap, PROCRpap, PROCLstone, PROCRstone.
PROCone	This is called from PROC name if a one player game is required. The player's name is placed in L$ and the word "BEEB" in R$.
PROCtwo	This is called from PROC name if a two player game is required. The name of the left hand player is placed in L$ and the right hand player in R$.
PROCOne	This is called from PROC play to input the player's choice in the one player game. Line 1660 beats the rhythm and

CONTINUED OVER

	then flushes the keyboard buffer (* fx21,0) ready for the GET$ input at line 1680. If the key pressed is one of the three allowed choices then the procedure ends and returns to PROCplay, else the message "You pressed the wrong key" is displayed and the program returns to Line 168.
PROCTwo	This is similar to the above and is called in the two player game. The rhythm is beat in Line 1400 (and keyboard buffer flushed) and the choice is input in Line 1420 by meand of GET$. Either player may press first, each press causing a "ping" to sound, but nothing is shown until the second player chooses. Various decisions are then made to determine if the keys pressed were valid keys or if, in the excitement, one player pressed twice or pressed two keys. The first player's choice is entered in X$, the second in Y$. These are then sorted so that the left hand player's choice is entered in A$ and the right hand in B$.
PROCLwin	This makes several comments depending on the relative score of the two players.
PROCRwin	This is similar to the above but the right hand player may be the BBC Computer in the one player game and so the comments are suitably modified.
PROCscore	This prints the current score.
PROCdraw	This is called from PROC play when the two choices are the same. It adds one to each player's score and prints — "A DRAW".
PROCLsciss	This prints "LEFT SCISSOR" and calls PROC sciss (1) which draws a pair of scissors at the position determined by the parameter.
PROCRsciss	As above but for the right hand scissors.
PROCLstone	As above but calls PROCstone (1) to draw a stone at a position determined by the parameter.
PROCRstone	As above but for the right hand stone.
PROCLpap	As above but calls PROCpap (1) to draw a piece of paper at a position determined by the parameter.
PROCRpap	As above but for the right hand paper.
PROCwait (X)	This is called on various occasions to cause a delay in the programme. The length of time determined by the parameter.
PROCcll (X,Y)	This is called on various occasions to clear a particular line at position X,Y in the parameter. It causes the STRING $ function to replace the existing line with a line of spaces.
PROCstone(X%,Y%)	This draws a diamond shape at position X%,Y% using the normal DRAW and MOVE commands. A diamond shape was chosen because it is easily and quickly drawn and is easily recognised as a stone. What shape would you choose.
PROCsciss (X)	This draws the scissor shape using redefined characters to print the shape. This was found necessary because of the speed required to draw a satisfactory pair of scissors without slowing down the action of the game.
PROCpap (X)	This draws a piece of paper at position X. The shape of the curling edge is determined by FOR-NEXT loop drawing a sine wave at 30° intervals. This is the slowest of the pictures drawn.

VARIABLES

A list of variables used is as follows:-

G$	= "SCISSOR — STONE — PAPER GAME"
S$	= "SCISSOR CUTS PAPER"
P$	= "PAPER WRAPS STONE"
s$	= "STONE BLUNTS SCISSORS"
A%	= Score of left hand player
B%	= Score of right hand player
P	= ASCII GET value in PROC name, which then redefines it as the number of players, i.e. P = 1 or 2
L$	= name of left hand player
R$	= name of right hand player or Beeb in the one player game
X$	= First player's choice
Y$	= Second player's choice
A$	= Left hand player's choice
B$	= Right hand player's choice
X,Y,I,I%	Used for various counters, sums, passing parameters, etc
W	= Wait parameter
X%,Y%	= X and Y co-ordinates in the drawing procedures

GAME EXPANSION

For anyone looking for programming ideas, the following may be of interest.

Although the game listed uses all the available memory in Mode 1, which was chosen because it has good graphics capability and reasonable colour, there are several ways in which the game could be expanded or improved:

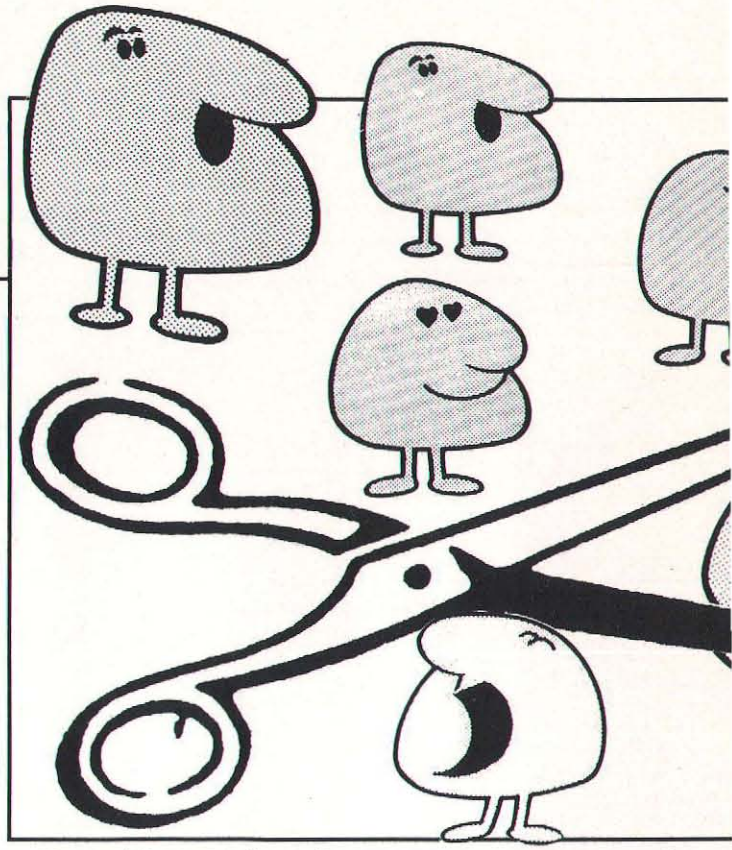
1. Remove all the introduction and instruction onto a separate program, then load this program with the rest of the game on. This may then release enough memory to allow for the animation of the game. For example, the snapping scissors cutting the paper in two; the scissors closing on the stone and sparks flying or the paper wrapping up the stone.
2. Use Mode 7 for the program. Obviously the resolution of the graphics in Mode 7 is not as fine as in Mode 1, but it may be quite acceptable and there would be plenty of memory for the animation. This could be an interesting challenge to explore the capabilities of Mode 7.
3. With a greater memory availability the number of wins or losses may be treated in a much more mathematical manner. A proper statistical analysis of the results could be a real test for mind reading ability (or electronic reading?).

PROGRAM LISTING

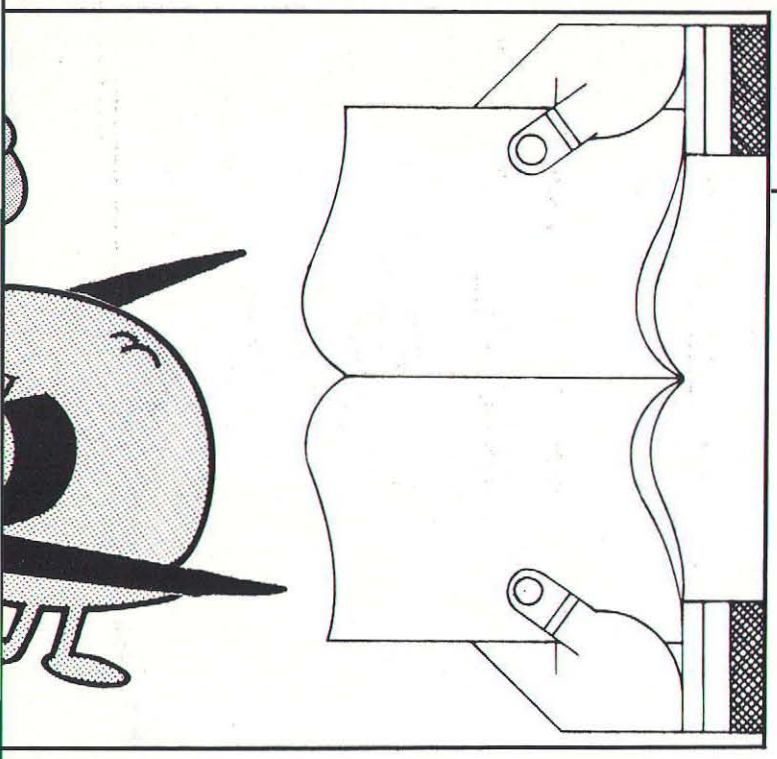
```
30 MODE 1
40 *KEY10OLD|MRUN|M
50 ON ERROR GOTO3000
```

```
  60 *FX202,16
  70 PROCvar
  80 PROCintro
  90 PROCinstr
 100 PROCname
 110 PROCchar
 120 REPEAT
 130 PROCplay
 140 UNTIL FALSE
 150 END
 160
 170 DEFPROCchar
 180 VDU23,224,&00,&F0,&FE,&FF,&FF,&FF,&0F,&01
 190 VDU23,225,&01,&0F,&FF,&FF,&FF,&FE,&F0,&00
 200 VDU23,226,&00,&00,&00,&00,&80,&C0,&F1,&FB
 210 VDU23,227,&FF,&7E,&3C,&39,&39,&3C,&7E,&FF
 220 VDU23,228,&FB,&F1,&C0,&80,&00,&00,&00,&00
 230 VDU23,229,&00,&00,&00,&00,&00,&00,&F0,&FB
 240 VDU23,230,&3F,&1F,&CF,&E7,&E6,&CF,&1F,&3F
 250 VDU23,231,&FB,&F1,&00,&00,&00,&00,&00,&00
 260 VDU23,232,&00,&00,&00,&00,&00,&00,&7F,&FF
 270 VDU23,233,&FF,&FF,&F8,&80,&00,&80,&F8,&FF
 280 VDU23,234,&FF,&FF,&7F,&00,&00,&00,&00,&00
 290 VDU23,235,&00,&00,&00,&00,&07,&FF,&FF,&FF
 300 VDU23,236,&FF,&F8,&00,&00,&00,&00,&F8,&FF
 310 VDU23,237,&FF,&FF,&FF,&00,&00,&00,&00,&00
 320 VDU23,238,&00,&00,&00,&03,&FF,&FF,&FF,&FF
 330 VDU23,239,&FC,&00,&00,&00,&00,&00,&00,&FC
 340 VDU23,240,&00,&00,&00,&FF,&FF,&FF,&FF,&FF
 350 VDU23,241,&00,&00,&00,&F0,&FC,&FE,&FF,&FF
 360 VDU23,242,&FF,&FE,&F8,&00,&00,&00,&00,&00
 370 VDU23,243,&00,&00,&01,&03,&06,&0C,&18,&18
 380 VDU23,244,&30,&30,&60,&60,&60,&60,&30,&30
 390 VDU23,245,&18,&18,&0C,&06,&03,&01,&00,&00
 400 VDU23,246,&0F,&7F,&F0,&80,&00,&00,&00,&00
 410 VDU23,247,&00,&00,&00,&00,&00,&F0,&7F,&0F
 420 VDU23,248,&C0,&F8,&3E,&03,&01,&00.&00.&00
 430 VDU23,249,&00,&00,&00,&01,&07,&3F,&FC,&C0
 440 VDU23,250,&00,&00,&00,&00,&80,&C0,&C0,&C0
 450 VDU23,251,&30,&30,&18,&18,&18,&18,&38,&38
 460 VDU23,252,&7C,&7F,&FF,&FF,&FF,&80,&00,&00
 470 VDU23,253,&00,&00,&80,&FF,&FF,&FF,&7F,&7C
 480 VDU23,254,&60,&60,&C0,&C0,&80,&80,&00,&00
 490 ENDPROC
 500
 510 DEFPROCvar
 520 G$="SCISSOR-STONE-PAPER GAME"
 530 S$="SCISSORS CUTS PAPER"
 540 P$="PAPER WRAPS STONE"
 550 s$="STONE BLUNTS SCISSORS"
 560 A%=0:B%=0
 570 ENDPROC
 580
 590 DEFPROCintro
 600 VDU19,128,132,0,0,0,19,1,9,0,0,0
 610 ENVELOPE1,3,1,-1,0,2,2,0,4,0,0,-2,126,126
 620 ENVELOPE2,1,0,0,0,1,1,1,127,-1,-1,-1,126,1
 630 ENVELOPE3,2,-96,71,4,1,53,239,30,0,0,-10,126
,126
 640 CLS:PRINTTAB(9,1)G$
 650 PRINTTAB(5,3)"The Scissor-Stone-Paper game i
s"'"usually a game for two players requiringno mor
e equipment than their two hands."
 660 PRINT"  The two players face each other and"
'"beat a rhythm with their left hand;theirright ha
nd hidden behind their backs."
 670 PRINT"Simultaneously they bring their right"
'"hands to the front with their hands"'"forming a
shape to represent either"'"scissors,stone or pape
r.  For example:"
 680 PRINT'"  First & second fingers = SCISSORS"
TAB(12)"A closed fist = STONE"TAB(14)"A flat hand
= PAPER"
 690 PRINT'"The rules are:Scissors CUTS paper"TAB
(17)"Paper WRAPS stone"TAB(17)"Stone BLUNTS scisso
rs"
 700 PRINT'"For example:If one player chooses"'"s
cissors,and the other chooses paper"'"then scissor
s wins"
 710 PRINT"  Hence it is a game of anticipation,"
'"intuition,telepathy,or"'"extra sensory perceptio
n."
 720 PRINT'"PRESS THE SPACE BAR FOR INSTRUCTIONS
"
 730 IFGET$=" "THENENDPROC
 740 GOTO720
 750
 760 DEFPROCinstr
 770 SOUND2,1,100,80
 780 CLS:PRINTTAB(7,1)G$
 790 PRINTTAB(5,3)"In this version of the game th
ere"'"may be two players,or one against the"TAB(18
,5)"BEEB"
 800 PRINTTAB(5,7)"Three keys are used by each pl
ayer,the idea is that a player cups a hand"'"aroun
d the keys so that the other"'"player cannot see t
he key pressed."
 810  PRINT"The computer recognises which key was
"'"pressed immediately but does not show"'"anythin
g on the screen until the second player presses a
key."
 820 PRINTTAB(5)"In the single player version the
"'"player uses the left hand keys,the"'"computer c
hooses at random before the"'"player chooses."
 830 PRINT'"   The keys used are as follows:"
 840 PRINTTAB(2,22)"SINGLE PLAYER AND"TAB(2,23)"L
EFT HAND PLAYER"TAB(23,23)"RIGHT HAND PLAYER"
 845 REM control keys can be redefined to suit th
e Electron keyboard or individual preference.
 850 PRINTTAB(6,25)"Q=SCISSORS"TAB(27,25)"(=SCISS
ORS"
 860 PRINTTAB(6,26)"A=STONE"TAB(27,26)"*=STONE"
 870 PRINTTAB(6,27)"Z=PAPER"TAB(27,27)"?=PAPER"
 880 PRINTTAB(2,30)"PRESS THE SPACE BAR TO START
THE GAME"
 890 IFGET$=" "THENENDPROC
 900 GOTO880
 910
 920 DEFPROCname
 930 CLS:PRINTTAB(7,1)G$'"ARE THERE 1 OR 2 PLAYE
RS ?":P=GET
 950 IFP=33 ORP=49THENP=1:PROCone:ENDPROC
 960 IFP=34 ORP=50THENP=2:PROCtwo:ENDPROC
 970 GOTO930
 980
 990 DEFPROCtwo
1000 CLS:PRINTTAB(9,1)G$
1010 INPUTTAB(2,5)"NAME OF LEFT HAND PLAYER ",L$
1020 INPUTTAB(2,7)"NAME OF RIGHT HAND PLAYER ",R$
1030 PRINTTAB(4,15)"HELLO ";L$;" AND ";R$''TAB(4)
"I AM PLEASED TO MEET YOU"
1040 PRINTTAB(4,30)"PRESS THE SPACE BAR TO CONTIN
```

CONTINUED OVER



```
UE"
 1050 IFGET$=" "THENENDPROC
 1060 GOTO1040
 1070
 1080 DEFPROCone
 1090 CLS:PRINTTAB(7,1)G$
 1100 INPUTTAB(4,5)"WHAT IS YOUR NAME ",L$
 1110 R$="BEEB"
 1120 PRINTTAB(4,15)"HELLO ";L$''TAB(4)"I AM PLEAS
ED TO MEET YOU"
 1130 PRINTTAB(4,30)"PRESS THE SPACE BAR TO CONTIN
UE"
 1140 IFGET$=" "THENENDPROC
 1150 GOTO1130
 1160
 1170 DEFPROCplay
 1180 CLS:PRINTTAB(7,1)G$
 1190 COLOUR2:PRINTTAB(5,4)L$,TAB(21)R$
 1200 COLOUR3:PRINTTAB(5,6)"SCORE"TAB(21)"SCORE"
 1210 PRINTTAB(7,7);A%TAB(28,7);B%
 1220 IFP=2THENPROCTwo ELSEPROCOne
 1230 IFA$="Q"ANDB$="{"THEN PROCdraw:PROCLsciss:PR
OCRsciss
 1240 IFA$="A"ANDB$="*"THEN PROCdraw:PROCLstone:PR
OCRstone
 1250 IFA$="Z"ANDB$="?"THEN PROCdraw:PROCLpap:PROC
Rpap
 1260 IFA$="Q"ANDB$="?"THEN PROCLwin:PROCLsciss:PR
OCRpap:PRINTTAB(8,25)S$
 1270 IFA$="A"ANDB$="{"THEN PROCLwin:PROCLstone:PR
OCRsciss:PRINTTAB(8,25)s$
 1280 IFA$="Z"ANDB$="*"THEN PROCLwin:PROCLpap:PROC
Rstone:PRINTTAB(10,25)P$
 1290 IFA$="Q"ANDB$="*"THEN PROCRwin:PROCLsciss:PR
OCRstone:PRINTTAB(8,25)s$
 1300 IFA$="Z"ANDB$="{"THEN PROCRwin:PROCLpap:PROC
Rsciss:PRINTTAB(8,25)S$
 1310 IFA$="A"ANDB$="?"THEN PROCRwin:PROCLstone:PR
OCRpap:PRINTTAB(10,25)P$
 1320 PRINTTAB(4,30)"PRESS SPACE BAR FOR ANOTHER G
AME"
 1330 IFGET$=" "THENENDPROC
 1340 GOTO1320
 1350
 1360 DEFPROCTwo
 1370 PROCcll(22)
 1380 *FX202,16
 1390 PRINTTAB(3,20)"PRESS THE KEY WHEN YOU ARE RE
ADY"
 1400 PRINTTAB(18,10)" ":FORJ=1TO3:SOUND2,2,40,20:
PRINTTAB(17,10);J:PROCwait(8):NEXTJ:*FX21,0
 1410 PRINTTAB(17,10)"GO"
 1420 X$=GET$:SOUND1,2,220,10:Y$=GET$:SOUND1,2,230
 10
 1430 X=ASC(X$):Y=ASC(Y$):Z=X+Y
 1440 IFX=81ORX=65ORX=90ORX=123ORX=42ORX=63THEN GO
TO1450 ELSE GOTO1460
 1450 IFY=81ORY=65ORY=90ORY=123ORY=42ORY=63THEN GO
TO1470 ELSE GOTO1460
 1460 PRINTTAB(1,22)"THE WRONG KEY WAS PRESSED BY
SOMEONE.":PROCwait(20):GOTO1370
 1470 IFX=Y THEN IF X=81 ORX=65 ORX=90 THEN PRINTT
AB(1,22)"STEADY ";L$;" YOU PRESSED A KEY TWICE":PR
OCwait(20):GOTO1370
 1480 IFX=Y THEN IF X=123 ORX=42 ORX=63 THEN PRINT
TAB(1,22)"STEADY ";R$;" YOU PRESSED A KEY TWICE":P
ROCwait(20):GOTO1370
 1490 IFZ=146 ORZ=171 ORZ=155 THEN PRINTTAB(1,22)"
STEADY ";L$;" YOU PRESSED TWO KEYS.":PROCwait(20):
GOTO1370
 1500 IFZ=165 ORZ=186 ORZ=105 THEN PRINTTAB(1,22)"
STEADY ";R$;" YOU PRESSED TWO KEYS.":PROCwait(20):
GOTO1370
 1510 IFX$="Q"ORX$="A"ORX$="Z"THENA$=X$
 1520 IFY$="Q"ORY$="A"ORY$="Z"THENA$=Y$
 1530 IFX$="{"ORX$="*"ORX$="?"THENB$=X$
 1540 IFY$="{"ORY$="*"ORY$="?"THENB$=Y$
 1550 ENDPROC
 1560
 1570 DEFPROCOne
 1580 Y=RND(3)
 1590 ON Y GOTO 1600,1610,1620
 1600 B$="{":GOTO1630
 1610 B$="*":GOTO1630
 1620 B$="?"
 1630 PRINTTAB(3,20)"PRESS THE KEY WHEN YOU ARE RE
ADY"
 1640 PROCcll(22)
 1650 *FX202,16
 1660 PRINTTAB(17,10)"  ":FORJ=1TO3:SOUND2,2,40,15
:PRINTTAB(17,10);J:PROCwait(6):NEXTJ:*FX21,0
 1670 PRINTTAB(17,10)"GO"
 1680 X$=GET$
 1690 IFX$="Q"ORX$="A"ORX$="Z"THENA$=X$:ENDPROC
 1700 PRINTTAB(1,22)"YOU PRESSED THE WRONG KEY ";L
$
 1710 PROCwait(20):GOTO1640
 1720 ENDPROC
 1730
 1740 DEFPROCLwin
 1750 A%=A%+1
 1755 SOUND1,3,89,40
 1760 PROCscore(1,2)
 1770 IFA%>12 THEN IF A%>2*B%THENPRINTTAB(0,28)"YO
U'VE EXTRA SENSORY PERCEPTION ";L$:ENDPROC
 1780 IFA%>6 THEN IF A%>1.3*B%THENPRINTTAB(7,28)"A
RE YOU TELEPATHIC ";L$:ENDPROC
 1790 ENDPROC
```



```
 1800
 1810 DEFPROCRwin
 1820 B%=B%+1
 1825 SOUND1,3,89,40
 1830 PROCscore(2,1)
 1840 IFP=1 THEN IF B%>10 AND B%>2*A%THENPRINTTAB(
2,28)"I MUST HAVE EXTRA SENSORY PERCEPTION":ENDPROC
 1850 IFP=1 THEN IF B%>5 AND B%>1.3*A%THENPRINTTAB
(8,28)"I MUST BE TELEPATHIC":ENDPROC
 1860 IFB%>12 THEN IF B%>2*A%THENPRINTTAB(0,28)"YO
U'VE EXTRA SENSORY PERCEPTION ";R$:ENDPROC
 1870 IFB%>6 THEN IF B%>1.3*A%THENPRINTTAB(7,28)"A
RE YOU TELEPATHIC ";R$:ENDPROC
 1880 ENDPROC
 1890
 1900 DEFPROCscore(X,Y)
 1920 PROCcll(4):PROCcll(20)
 1930 COLOURX:PRINTTAB(5,4)L$
 1940 COLOURY:PRINTTAB(26,4)R$
 1950 COLOUR3:PRINTTAB(7,7);A%TAB(21);B%:COLOUR2
 1960 ENDPROC
 1970
 1980 DEFPROCdraw
 1990 SOUND1,2,150,60
 2000 PROCcll(20)
 2010 A%=A%+1:B%=B%+1
 2020 PRINTTAB(7,7);A%TAB(28,7);B%;TAB(14,22)"A DR
AW"
 2040 ENDPROC
 2050
 2060 DEFPROCLsciss
 2070 PROCsciss(1)
 2080 PRINTTAB(2,20)"LEFT SCISSOR"
 2090 ENDPROC
 2100
 2110 DEFPROCcll(L)
 2120 PRINTTAB(1,L)STRING$(40," ")
 2130 ENDPROC
 2140
 2150 DEFPROCRsciss
 2160 PROCsciss(24)
 2170 PRINTTAB(23,20)"RIGHT SCISSOR"
 2180 ENDPROC
 2190
 2200 DEFPROCLstone
 2210 PROCstone(140,600)
 2220 PRINTTAB(3,20)"LEFT STONE"
 2230 ENDPROC
 2240
 2250 DEFPROCRstone
 2260 PROCstone(800,600)
 2270 PRINTTAB(23,20)"RIGHT STONE"
 2280 ENDPROC
 2290
 2300 DEFPROCLpap
 2310 PROCpap(1)
 2320 PRINTTAB(3,20)"LEFT PAPER"
 2330 ENDPROC
 2340
 2350 DEFPROCRpap
 2360 PROCpap(700)
 2370 PRINTTAB(23,20)"RIGHT PAPER"
 2380 ENDPROC
 2390
 2400 DEFPROCwait(W)
 2410 FORI=1TO200*W:NEXT
 2420 ENDPROC
 2430
 2440 DEFPROCstone(X%,Y%)
 2450 MOVEX%,Y%:DRAWX%+60,Y%+50:DRAWX%+160,Y%+50:D
RAWX%+220,Y%:DRAWX%+160,Y%-50:DRAWX%+60,Y%-50:DRAW
X%,Y%
 2460 DRAWX%+20,Y%+10:DRAWX%+70,Y%+40:DRAWX%+150,Y
%+40:DRAWX%+200,Y%+10:DRAWX%+150,Y%-20:DRAWX%+70,Y
%-20:DRAWX%+20,Y%+10
 2470 MOVEX%+70,Y%+40:DRAWX%+60,Y%+50:MOVEX%+160,Y
%+50:DRAWX%+150,Y%+40:MOVEX%+220,Y%:DRAWX%+200,Y%+
10:MOVEX%+150,Y%-20:DRAWX%+160,Y%-50:MOVEX%+60,Y%-
50:DRAWX%+70,Y%-20
 2480 MOVEX%,Y%:DRAWX%+110,Y%-140:DRAWX%+60,Y%-50:
MOVEX%+160,Y%-50:DRAWX%+110,Y%-140:DRAWX%+220,Y%
 2490 ENDPROC
 2500
 2510 DEFPROCsciss(X)
 2520 PRINTTAB(1,10)
 2530 FORI=1TOX:VDU9:NEXT
 2540 VDU243,246,248,250,&A,8,8,8,8,244,9,9,251,&A
,8,8,8,8,245,247,249,252
 2550 VDU224,226,229,232,&A,8,8,8,8,9,227,230,233,
&A,8,8,8,8,225,228,231,234
 2560 VDU&B,&B,235,238,240,241,&A,8,8,8,8,236,239,
&A,8,8,237,237,237,242
 2570 PRINTTAB(1,14)
 2580 FORI=1TOX:VDU9:NEXT
 2590 VDU243,246,248,253,&A,8,8,8,8,244,9,9,251,&A
,8,8,8,8,245,247,249,254
 2600 ENDPROC
 2610
 2620 DEFPROCpap(X)
 2630 X%=X+150:MOVEX%,650
 2640 FORI%=0TO360STEP30:DRAWX%+15*SIN(RAD(I%)),65
0-I%/2:NEXT
 2650 DRAWX%+200,470
 2660 FORI%=0TO360STEP30:DRAWX%+200-15*SIN(RAD(I%)
),470+I%/2:NEXT
 2670 DRAWX%,650
 2680 ENDPROC
 2690
 3000 IF ERR=17 THEN RUN
 3010 REPORT
```

Software Listings

Want a program for your BBC Micro or Acorn Electron? Look no further than our listings to make your choice.

Finding and choosing the correct software for your needs is a daunting task indeed, whether you are looking for a word processing package or for a new game to test your alien destroying, treasure seeking, path-finding talents!

Often you can be put off even looking through the pages of advertisements which tempt you with vivid descriptions o f the amazing graphics and sound effects of the game being offered, you sit there with pen poised above cheque book and your eye catches the small print that tells you that the game will run on just about every available machine except the one sitting beside you!

But BBC and Electron owners need despair no longer — help is at hand in the following pages. We have put together as comprehensive a list as possible of the software available for these machines. In order to fit in as many as possible we have had to use codes in some columns. The title of the software, whether it is for the BBC or the Electron, the company which produces it, the form in which it is available, the supplier code and price; all are given for each piece of software listed. The codes used are:

Code	Explanation
Gm	Game
Bs	Business
Ut	Programming utility
Do	Domestic
Ed	Educational
A	Model A BBC
B	Model B BBC
E	Electron
C	Cassette
D()	Disc (40 or 80)
R	Rom or Eprom

As you are probably aware, new software is surfacing all the time so do not asume that there is no such item as the one you are looking for, if it is not included in the following list. Remember that much BBC software is being converted for the Electron and to avoid dissapointment it is best to wait for a specifically written program. If you are aware of a piece of software that is not listed here, whether you are a user or a producer, feel free to let us know.

SOFTWARE LISTINGS

Title	Type	Manufacturers	Memory		Software Supplier	Price
ABC	Ed	Acornsoft	B	C,D	AL	£9.95, £11.50
ABC	Ed	Bryants	B	C	HW	£4.85
Abductor	Gm	Salamander	A,B	C	NZ	£7.95
ABM	Gm	Alligata	A,B	C	AG	£5.95
Abyss	Gm	Cases	B,E	C	CE	£6.95
A Cluster of Curves	Ed	Chaddington	B,E	C,D	CN	£10.00
Action of the Heart	Ed	Garland Comp.	B	C	JX	£11.76
Accounting Ratios	Bs	Microplex	B	C	MP	£7.95
Accounts Receivable	Bs	Acornsoft	B	D	AL	£24.95
Accounts Payable	Bs	Acornsoft	B	D	AL	£24.95
Accurate	Ed	MP Software	B	C,D		£11.00/ £14.00
Acids and Alkalis	Ed	Scholar	B	C,D	SC	£5.50, £7.50
Addcomm	Yt	Vine	B	R	VI	£28.00
Add-Tabs and Mul-Tabs	Ed	Cottage Soft	A,B	C	CT	£7.50
Ade	Ut	System	B	R	SY	£60.00
Adventure	Gm	Micro Power	A,B,E	C	GK	£7.95
Adventure 1	Gm	Odyssey	B	C	OG	£4.50
Adventure 2	Gm	Odyssey	B	C	OG	£4.50
Adventure	GM	Program Direct	B	C	NP	£5.99
Adventureland	Gm	Adventure International	B,E,	C	AI	£7.95
Adventure Quest	Gm	Level 9 Computing	B	C	CU	£9.90
Adventure Quiz	Ed	Dial	B	C,DL		£4.95, £6.50
Airline	Gm	Cases	B	C	CE	£6.95
Algebraic Manipulation	Ut	Acornsoft	B	C	AL	£9.95
Alien	Gm	FBC	B	C	FB	£6.00
Alien Break-in	Gm	Romik	B,E	C	RO	£6.99
Alien Destroyer	Gm	Beebug	B	C	BE	£7.50
Alien Destroyers	Gm	Micro Power	B	C	GK	£7.95
Alienswirl	Gm	Amcom	B	C	AO	£5.95
Alien Swirl	Gm	Micro Power	B	C	GK	£6.95
Airlift	Gm	Bug Byte	B	C	KP	£5.50
Allaboard	Ed	Arnold-Wheaton	B	C	AW	£9.95 + VAT
Alligatacalc	Do	Alligata	B	C	SY	£9.95
Alpha Graph	Ed	Arnold-Wheaton	B	C,D	AW	£15.00 + VAT
Alien Dropout	Gm	Superior Software	B,E	C	SE	£7.95
All Fingers Go	Ed	NEC	B	C	NC	£14.95
Alpha	Ed	Golem	B	C	OB	£8.05
Alphachopper	Ed	Sulis	B	C	SU	£9.95
Alphabet	Ed	J B Software	B	C	JS	£4.95
Alphabeta	Bs	H and H Software	B	C	HH	£28.50
Amazing Ollie	Ed	Storm	B	C,D	SX	£6.05, £9.95
Anagrams	Do	Cylindrical Software	A,B	C	CY	£3.95
Analyser	Bs	Number One Systems	B	C,D	NO	£33/45
Angles and Parallel Lines	Ed	Scholar	B	C,D	SC	£5.50, £7.50
Angles and Triangles	Ed	Scholar	B	C,D	SC	£5.50, £7.50
Angle Tutor	Ed	Pee Bee	B	C,D	PB	£9.95, £12.45
Android Attack	Gm	Computer Concepts	B	C	GJ	£7.80
Anagram	Ed	Ed.Soft	B	C	ES	£4.95
Angles Navigate	Ed	Primary Programs	B	C	PP	£5.95
Angle(4)	Ed	Chalksoft	B	C	KT	£6.95
Angle Turner	Ed	Arnold-Wheaton	B	C,D	AW	£15 + VAT
Anglezap	Gm	Gem	B	DC	GM	£7.50
Animal/Vegetable/Mineral	Ed	Bourne	B,E	C	BO	£8.97, £10.98
Animal, Vegetable, Mineral	Ed	Arnold-Wheton	B	C,D	AW	£15 + VAT
Animated Arithmetic	Ed	LCL	A,B,E	C,D	LA	£6.50 £7.50
Answer Back	Do	Kosmos	B,E	C	KM	£10.95
Android Attack	Gm	Computer Concepts	B	C	GJ	£8.95
Animated Arithmetic	Ed	Ludinski CAL	B	C/D	KA	£6.50/ £7.50
Animator	Ut	Screenplay	B	C	SC	£11.95
Animator	Ed	Arnold-Wheaton	B	C,D	AW	£9.95, £12.00 + VAT
Apollo	Gm	Software Invasion	B	C	IS	£6.95
Append It	Ut	Aztec S/W	B	C	IB	£3.00
Apocalypse	Gm	Red Shift	B	C	RS	£9.95
Arcadians	Gm	Acornsoft	B,E	C	AL	£9.95, £9.20
Arcade Action	Gm	Acornsoft	B	C	GA	£11.90
Arcade 1	Gm	Odyssey	B	C	OG	£3.00
Arcade Games	Gm	Ganymede Systems	B	C	GY	£9.95
Area of Rectangles	Ed	Scholar	B	C,D	SC	£5.00, £7.00
Area of Triangles	Ed	Scholar	B	C,D	SC	£7.00, £9.00

Area Radar Controller	Gm	Software For All	B	C	KN	£6.95
Arithmetic Plus 1-4	Ed	Fernleaf	B	C,D	FE	£35.95
Arrow of Death (1)	Gm	Digital Fantasia	B	C	JT	£6.95
Arrow of Death (2)	Gm	Digital Fantasia	B	C	NT	£8.95
Art Designer	Ut	Pica	B,E	C,D	PI	£7.95, £9.75
Artist	Ut	MRM	B	C	MR	£6.95
Artisan I	Ut	OIC	B,E	C	OI	£12.75
Artist	Ut	MRM	B	C	MR	£6.95
Asteroid Storm	Gm	Micro Power	B,E	C	GK	£7.95
Asteroids/Frong	Gm	Aardvark Software	B	C	IU	£4.00
Asteroid Belt	Gm	Electronics Appplied	B	C	IF	£11.50
Asteroid Belt	Gm	Computer Concepts	B	C	GJ	£7.80
Asteroid Miner	Gm	Optima	B	C	OP	£8.95
Astro Navigator	Gm	Micro Power	B	C	GK,	£6.95
Astronomy	Do	BBC	B	C,D	KB	£9.95, £11.50
Astrowars	Gm	Simonsoft	B	C	SI	£6.95
Atlantis	Gm	IJK Software	B	C	IT	£6.95
Atomic Protector	Gm	Optima	B	C	OP	£8.95
Atom Smasher	Gm	Romik	B,E	C	RO	£6.99
Another	Ed	Davy Computing	B	D	DA	£30.00 + VAT
Aviator	Gm	Acornsoft	B	C,D	AL	£14.95, £17.65
Awari	Gm	Foilkade	B	C	NR	£5.95
Backgammon	Ut	Bug Byte	B	C	BB	£8.00
Bailiff	Ed	Sulis	B	C	SU	£9.95
Balance Your Diet	Ed	Cambridge Micro	B	C,D	CM	£13.95 + £1.62
Ballard	Ed	Ed.Soft	B	C	ES	£3.00
Ballooning	Ed	Heinemann	B	C	HE	£7.25 + VAT
Balloons	Gm	C J E Micros	B	C	NV	£6.00
Bandits at 3 O'Clock	Gm	Micro Power	B,E	C	GK	£6.95
Bank	Ed	Primary	B	C,D	PP	£5.95, £7.95
Bank Statement	Ed	Scholar	B	C,D	SC	£6.00, £8.00
Banner	Do	Micro-Aid	A,B	C	IZ	£2.95
Barset and Barpic	Ed	Longman	B	C,D	LM	£14.50 + VAT
Barrage	Ed	Micro Power	B	C	GK	£7.95
Base 10	Ed	Dial	B	C,D	DL	£4.95, £6,50
BASIC Compiler	Ut	Ack	B	C,D	AC	£14.95, £19.95
BASIC Environment	Ut	Harris	B	D	HM	£14.50
Basic Goodies	Ut	Simonsoft	A,B	C	MS	£5.95
Basic Maths	Ed	Aztec S/W	A,B	C	IB	£3.00
Basic Number Help	Ed	Longman	B	C,D	LM	£9.95, £12.95
Basic Statistics	Bs	Micropak	B	C	MP	£7.95
Battlezone Six	Gm	Kansas	B	C	KA	£9.50
Battlezone 2000	Gm	Lothlorien	B	C	LO	£6.95
Battle Tank	Gm	Superior Software	B	C	SE	£7.95
BBC Artfun	Do	R.H. Electronics	B	C	RH	£9.95
BBC Kaleidoscope	Ed	Dial	B	C	DL	£8.50
BBC Logo	Ed	Dial	B	C,D	DL	£6.50, £8.00
BBC Octuplet	Ed	Dial	B	C	DL	£8.50
BCPL Stand Alone Generator	Ut	Acornsoft	B	D	AL	£49.90
BCPL Calculations	Ut	Acornsoft	B	D	AL	£9.95, £11.50
Beamscan	Bs	Beamscan	B	C,D	BS	£40,45
Beat the Bug (Molecule)	Gm	Bridge	B	C	BR	£6.90
Beat the Clock	Ed	Arnold-Wheaton	B	C,D	AW	£15 + VAT
Bed Bugs	Gm	Optima	B	C	OP	£8.95
Beebart	Ut	Quicksilva	B	C	QS	£14.95
Bee Base	Ut	GCC	B	E	GL	£45.94
Beeb-Chase	Gm	Database Software	B	C	NU	£7.50
Beebmunch	Gm	I.J.K. S/W	B	C	IJ	£5.95
Beebtrek	Gm	Software for All	A,B	C	KN	£7.95
Bells	Ed	Dial	B	C,D	DL	£4.95, £6.50
BEEP-BEEB	Gm	IJK	B	C	IJ	£3.95
Beep-Beeb (Super Simon)	Gm	IJK Software	B	C	IJ	£4.50
Beebcalc	Bs	Gemini	B	C	GM	£19.95
Beebmon	Ut	Micro Power	A,B	C	GK	£7.95
Beebplot	Bs	Gemini	B	C	GM	£19.95
Beeboids	Gm	Odyssey	A,B	C	OG	£2.75

SOFTWARE SUPPLIERS

Supplier Code

AA Anthony Aspitel Software Systems
56 London Road
Harleston
Norfolk
IP20 9BZ

AB ABC Primary
19 Crumstone Court
Longmeadow Estate
Killingworth
Newcastle Upon Tyne

AC ACK Data
21 Salcombe Drive
Nottingham NG5 8JF

AD Dial Software
72 Downend Road
Downend
Bristol

AG Superior Systems Ltd
178 West Street
Sheffield WS1 4ET

AJ AJ Software
61 Jeddo Road
London WIZ 9ED

AK A.S.K. Ltd
London House
68 Upper Richmond Road
London SW15 2RP

AL Acornsoft Ltd
4a Market Hill
Cambridge CB2 3NJ

AM Microplus Software
6 Litton Way
Leeds

AN Addison-Wesley
53 Bedford Square
London WC1B 3DZ

AO Amcom
23 Hivings Hill
Chesham
Bucks HP5 2PG

AP Processor Applications
22 Mercer Close
Basingstoke
Hants

AR Aardvark Software
100 Ardleigh Green Road
Hornchurch
Essex RM11 2LG

AS ASP Software
Number One Golden Square
London W1R 3AB

AT ATM
King's Chambers
Queen Street
Derby DE1 3DA

AV A J Vision Service Ltd
61 Jeddo Road
London W12 9ED

AW Arnold-Wheaton Software
Software Publishing Division
Parkside Lane
Leeds LS11 5TD

BB Bug-Byte
Mulberry House
Canning Place
Liverpool L1 8JB

BE Beebugsoft
PO Box 109
High Wycombe
Bucks HP11 2TD

BJ BJ Software
26 Fore Hill Avenue
Doncaster DN4 7EU

BK BAKsoft
34 Humberstone Road
Cambridge

BM Blue Moon Software Co.
Freepost
Swanley
Kent BR8 7UY

BO Bourne Educational
Bourne House
The Hundred
Romsey
Hampshire SO5 8BY

BO Bourne Educational Software
Headbourne Worthy
Winchester
Hants SO23 7SQ

BR Bridge Software
36 Fernwood
Marple Bridge
Stockport
Cheshire SK6 5BE

BS Beamscan
20 Vaughan Avenue
Hendon
London NW4 4HU

BT Beast International
Mustians
Eton, Windsor
Berkshire SL4 6EX

BU Busco
16 Colwill Walk
Mainstone
Plymouth

CA Carvells
3/7 Bank Street
Rugby

CR Carswell Computers
Carswell Barn
Faringdon
Oxon SN7 8JN

CD Carsondale Enterprises Ltd
44 Kingsway
Stoke-on-Trent
Staffordshire
ST4 1JH

CG Challenge Games
64 Ferndale Road
London E11

CH Chalksoft Ltd
37 Willowslea Road
Worchester WR3 7QP

CL Clwyd Technics Ltd.,
Microprocessor Centre
Coach House
Kelsterton Road
Flint
Clwyd CH6 5TH

CONTINUED OVER

SOFTWARE LISTINGS

Title	Type	Manufacturers	Memory		Software Supplier	Price
Beebon Mon	Ut	McKeran	A,B	C	MK	£2.00
Beebmon	Ut	Watford	B	R	WA	£22.00
Beebsynth	Ut	Clares	A,B	C	CL	£7.95
Beeb-Tote	Gm	Micro Power	B	C	GK	£5.95
Beefeater	Ed	Sulis	B	C	SU	£7.95
Bertie Bear	Ed	Dial	B	C,D	DL	£4.95, £6.50
Besieged	Ed	Sulis	B	C	SU	£9.95
Beyond Basic	Ed	BBC/NEC	A,B	C	KB	£7.25
Billiards	Gm	H and H Software	B	C	HH	£8.50
Binary Numbers	Ed	Chaddington	B,E	C,D	CN	£10.00
Birds of Prey	Gm	Romik	B,E	C	RO	£6.99
Bismark	Gm	ASP Software	B,E	C	AS	£6.99
Black Box and Gambit	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Blackjack/Textpro	Gm	Software Invasion	B	C	IS	£6.95
Blagger	Gm	Alligata	B,E	C	SY	£7.95
Blockbuster	Gm	Micro Power	B	C	GK	£7.95
Blockfit	Ed	System	B	D	SY	£46.00
Blue Dragon	Gm	MP	B,E	C,D	MP	£7.48, £10.50
Boat Race	Ed /Ut	Pee Bee	B	C,D	PB	£8.50, £11.00
Boeing 767	GM	Flightdeck	B	C	FL	£7.67
Bomb Alley	Gm	Software Invasion	B	C	IS	£7.95
Bomber Scramble	Gm	Kansas	B	C	KA	£9.50
Bounce	Gm	Computercat	A,B	C	CC	£4.95
Bouncer	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Bouncers	Gm	A&F	B	C	GE	£8.00
Bounty Pirates	Gm	Aztec S/W	A,B	C	IB	£5.50
Boris in the Underworld	Gm	Superior	B	C	SE	£7.95
Boxes/Maze	Ed	Primary	B	C,D	PP	£5.95, £7.95
Boxer	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Brain Teasers	Gm	Dynabyte	A,B	C	DB	£5.95
Break-in	Ed	Highlight	B	C,D	HI	£6.00, £7.00
Break-Up	Gm	Miking S/W	B	C	KC	£3.95
Breakout	Gm	I.J.K. S/W	A,B	C	IJ	£3.95
Breakout	Gm	Bryants S/W	B	C	HW	£3.75
Brick 'em in	Gm	Software For All	B	C	KN	£6.95
Bridge to the East	Gm	Ixion	B	C	IN	£8.05
Bridgeman	Gm	Bridge	B	C	BR	£6.90
Budget	Do	Micro-Aid	B	C,D,F	IZ	£9.95, £11.70
Budget	Bs	Micropax	B	C	MP	£7.95
Budget-Multiproduct	Bs	Micropax	B	C	MP	£12.95
Budget-Multiproduct	Bs	Micropax	B	D	MP	£25.00
Bugblaster	Gm	Alligata	B,E	C	SY	£7.95
Bug Bomb	Gm	Virgin Games	B	C	VG	£7.95
Bumble Bee	Gm	Micro Power	B	C	GK	£7.95
Business Game	Ed	Acornsoft	A,B	C	AL	£9.95, £9.20
Bun Fun	Gm	Squirrel Software	A,B	C	SS	£6.50
Caesar the Cat	Es	Mirror	B	C	MR	£6.95
CaLIGNA –	Gm	Golden Challenge	B	C.D	GC	£7.95, 10.00
Canyon	Gm	BBC Pubs	B	C	KB	£10.00
Capitals	Ed	Edsoft	B	C	ES	£5.95
Capitals and Punctuation	Ed	RJE Software	A,B	C	RJ	£4.95
Carbohydrate Metabolism	Ed	Garland Comp.	B	C	JX	£18.24
Careers Analysis	Ed	Arnold-Wheaton	B	D	AW	£155 + VAT
Careers Information	Ed	Arnold-Wheaton	B	D	AW	£45 + VAT
Car Journey	Ed	Heinemann	B	C	HE	£9.25 + VAT
Caplett 1	Ed	Scholar	B	C,D	SC	£7.00, £9.00
Caplett 2	Ed	Scholar	B	C,D	SC	£5.50, £7.50
Carousel	Gm	Acornsoft	B	C	AL	£9.95
Car Race	Gm	Kingfisher	B	C	KF	£6.90
Cashbook Accounts	Bs	Gemini	B	C	GM	£59.95
Cashbook	Do	Micro-Aid	B	C	IZ	£5.95
Cashbook	Do	Micro-aid	A,B	C	IZ	£13.95
Cassette 99	Ed	Ludinski CAL	A,B,E	C	KA	£5.00
Castaway	Gm	Simonsofy	B	C,D	SI	£8.95
Castle of Riddles	Gm	Acornsoft	B	C	AL	£9.95
Catalog	Bs	Dialog	B	C/D	DG	£19.50
Catalogue	Ut	Baksoft	A,B	C	BK	£4.00
Cat and Mouse	Ed	Kingfisher	A,B	C	KF	£6.90
Cat & Mouse	Gm	Micro Power	A,B	C	GK	£4.95
Catchapple	Ed	Kingfisher	A,B	C	KF	£6.90
Caveman Adventure	Gm	Program Power	B	C	GK	£6.95
Caves of Anoran	Gm	FBC Systems	B	C	FB	£7.00
Cells & Serpants	Gm	ASP Software	B,E	C	AS	£6.99
Cells & Serpent	Gm	Hexagon S/W	A,B	C	JA	£5.00
Centibug	Gm	Superior	B,E	C	SE	£7.95
Central Heating	Ed	Heinemann	B	C	HE	£9.25 + VAT
Cesil	Ed	Dial	B	C,D	DL	£6.50, £8.00
CESCIL	Ed	Eduquest	A,B	C	NW	£19.95
Cesil Interpreter	Ed	Computersmith	B	C	LC	£15.00
Challenger	Gm	Joe the Liar	B	C	JL	£7.45
Character Shapemaker	Ut	Square	B	C	SQ	£7.00
Chargen	Ut	Busco	A,B	C	BU	£3.95
Chargen and Demo	Ut	Rainbow Research	B	C	RR	£8.50
Character Builder	Ut	Davensoft	A,B	C	NX	£4.95
Character Definer	Ut	A.J.	B	C,D	AJ	£9.95
Character Enlarger	Ut	Cylindrical Software	A,B	C	CY	£3.95
Character Orientating	Ut	Cylindrical Software	A,B	C	CY	£3.95
Character Generator	Ut	MP S/W	B	C	JZ	£3.00
Character Generator	Ut	Software for All	B	C	KN	£4.95
Characters	Ut	Computer Concepts	A,B	C	GJ	£6.67
Characters & Envelope Definer	Ut	Electronics Applied	B	C	IF	£5.50
Chard	Ut	System	B	C	SY	£9.00
Chargen	Ut	Odyssey	A,B	C	OG	£4.50
Chemical Analysis	Ed	Acornsoft	B	C	AL	£13.80
Chemical Collisions	Ed	Cambridge Micro	B	D	CM	£15.00 + VAT
Chemical Simulations	Ed	Acornoft	B	C	AL	£13.80
Chemical Structures	Ed	Acornsoft	B	C	AL	£13.80
Chemistry	Ed	Micro Power	B,E	C	GK	£6.95
Chess	Gm	Micro Power	A,B	C	GK	£5.95
Chess	Gm	Micro Power	B,E	C	GK	£7.95
Chess	Gm	Acornsoft	B,E	C	AL	£9.95
Chess	Gm	Bug Byte	B	C	EA	£11.50
Chess	Gm	Superior	B,E	C	SE	£7.95
Children From Space	Ed	A.S.K.	B		AK	£9.95
Childs Play Pack	Ed	Dial	B	C,D	DL	£6.50, £8.00
CHI-Squared	Bs	Micropax	B	C	MP	£7.95
CHI-Squared, contingency tables	Bs	Micropax	B	C	MP	£7.95
Chords	Ed	Aztec	A,B	C	AZ	£6.50
Christmas Carols	Do	Ega Beva	B	C	EB	£9.95
Circle Tutor	Ed	Pee Bee	B	C,D	PB	£9.95, £12.45
Circus	Gm	Digital Fantasia	B	C	NT	£8.95
City Defense	Gm	Bug-BYte	B	C	BB	£7.50
Classification (In)vertebrates	Ed	Scholar	B	C,D	SC	£6.00, £8.00
Claude	Gm	Alligata	B	C	AG	£7.95
Claws	Ed	Bryants S/W	A,B	C	HW	£3.75
Clone Ranger	Ut	J.C. Software	B	D	JS	£11.60
Cloze	Ed	GED Software	B	C	GD	£4.50
Cloze Procedure	Ed	Bryants S/W	A,B	C	HW	£4.85
Code Breaker	Gm	Program Power	A,B	C	GK	£4.95
Code-Breaker	Ed	RJE Software	A,B	C	RJ	£4.95
Collectors Catalogue	Do	Acornsoft	B	C	AL	£9.95
Code Race	Ut	Computer Concepts	B	C	GJ	£6.67
Coin Analysis	Bs	Micro-Aid	B	C	IZ	£4.95
Colditz Adventure	Gm	Superior Software	B	C	SE	£7.95
Colossal Adventure	Gm	Level 9 Computing	B	C	CU	£9.90

Colour Snap	Ed	Ega Beva	B	C	EB	£11.95
COMAL	Ln	Acornsoft	B	R	AL	£49.85
Comatch	Ed	Clares	A,B	C	CL	£4.95
Combination Business Pack 1	Bs	Gemini	B	C,D	GM	£159.00
Combination Business Pack 2	Bs	Gemini	B	C,D	GM	£79.95
Combination Business Pack 3	Bs	Gemini	E	C	GM	£79.95
Combination Home Pack 1	Do	Gemini	B,E	C,D	GM	£79.95
Commercial Accounts	Bs	Gemini	B	C	GM	£19.95
Commstar	Ut	PACE	B	R	PA	£34.00
Community	Gm	Ixion	B	C	IN	£6.90
Compass	Ed	GED Software	B	C	GD	£4.50
Compendium	Gm	Computercat	B	C	CC	£5.95
Complete Machine Code Tutor	Ed	New Generation	B	C	NG	£14.95
Computr Applications Project	Ed	Addison-Wesley	B	D	AN	£70.00
Connect 4	Gm	Database Software	B	C	NU	£5.90
Conquering Everest	Gm	ASP Software	B,E	C	AS	£6.99
Constellation	Ed	Micro Power	B	C	GK	£6.95
Constellation	Do	Superior	E	C	SE	£7.95
Contours/Places	Ed	Primary	B	C,D	PP	£5.95, £7.95
Co-ordinates	Ed	Primary	B	C,D	PP	£5.95, £7.95
Contribution Analysis	BS	Micropax	B	C	MP	£7.95
Cookbook Wizardry	Do	Database Software	B	C	NU	£7.50
Copter Capers	Gm	A&F	B	C	GE	£6.90
Copy Disc	Ut	A.J.	B	C	AJ	£5.95
Corn Cropper	Gm	Cases	A,B,E	C	CE	£6.95
Corporate Climber	Gm	Dynabyte	B,E	C	DB	£7.95
Cosmic Asteroids	Gm	Alligata	B	C	AG	£4.95
Cosmic Combat	Gm	Micro Power	B	C	GK	£6.95
Cosmic Fighters	Gm	Kansas	B	C	KA	£9.50
Cosmic Kidnap	Gm	Superior	B	C	SE	£7.95
Coucapcur	Ed	Ed. Soft	B	C	ES	£4.95
Countdown to Doom	Gm	Acornsoft	B	C,R	AL	£9.95
Counter Attack	Gm	OIC	B	C	OI	£6.50
Counting	Ed	Clares	A,B	C	CL	£4.95
Counting	Ed	Cottage Software	B	C	CT	£9.50
Dairy Farmer	Ed	Heinemann	B	C	HE	£9.25 +VAT
Dallas	Gm	Cases	A,B,E	C	CE	£6.95
Dambusters	Gm	Alligata	B	C	SY	£7.95
Danger! UXB	Gm	Micro Power	B,E	C	GK	£7.95
Dap 1	Ut	Gnomonica	B,E	C	GN	£15
Dap 2	Ut	Gnemonica	B	C	GN	£20
Dare Devil Dennis	Gm	Visions	B	C	VI	£7.95
Darts	Gm	Superior	B	C	SE	£6.95
Database	Ut	Computercat	B	C	CC	£12.95
Database	Bs	Gemini	B	C	GM	£19.95
Data-Quiz	Ut	Bryants S/W	B	C	HW	£4.88
Database	Ut	R. H. Electronics	B	C	RH	£12.95
Database	Bs	Acornsoft	B	C,D	AL	£11.90 £15.35
Database	Ed	Ed. Soft	B	C	ES	£19.95
Database	Bs	Primasoft	B	C	CT	£9.95
Database	Bs	Computercat	A,B	C	IJ	£11.95
Database	Bs	Software for All	A,B	C	KN	£9.95
Data File	Do	Kansas	B	C	KA	£12.50
Datext	Ut	Optima	B	C	OP	£9.95
Dating Game	Do	Acornsoft	B	C	AL	£12.65
Decay	Ed	GSN	B	D	GS	£15.00
Defchr	Ut	Micro-Aid	A,B	C	IZ	£2.95
Demon Decorator	Gm	Micro Power	B	C	GK	£6.95
Demon Knight	Gm	ASP Software	B,E	C	AS	£6.99
Density and Circuit	Ed	Acornsoft	A,B	C	AL	£11.90
Descender	Gm	FBC Systems	B	C	FB	£7.50
Desert Trek	Ed	Trekkasoft	B	C,D	TR	£5.50
Design	Ut	Beebug	B	C,D	BE	£10.00, £19.00
Desk Diary	Bs	Acornsoft	A,B,E	C	AL	£9.95
Desperate Dan	Gm	Thor	B	C	TH	£5.95
Detective	Gm	ASP Software	B,E	C	AS	£6.99
Detective	Gm	Computersmith	B	C	LC	£5.50
Determination of Electrostatic	Ed	GSN	B	C,D	GS	£14.00, £15.00
Devil's Causeway	Gm	Anirog Computers	A,B	C	OA	£6.00
DFM Database	Bs	Dialog	B	C/D	DG	£24.00
DFS Upgrade	Ut	Alligata	B	E	SY	£29.95
DFM Mail Labels	Bs	Dialog	B	C/D	DG	£10.00
Dictator	Gm	D. K. Tronics	B	C	DK	£6.95
Digger	Gm	Visions	B	C	VI	£7.95
Disassembler	Ut	Superior	E	C	SE	£7.95

SOFTWARE SUPPLIERS

CM *Comsoft*
7 Roman Drive
Leeds
West Yorkshire
LS8 2DR

CN *Chaddington Software*
14 Selkirk Close
Worthing BN13 1PR

CO *Computer Rentals Ltd*
CRL House
9 Kings Yard
Carpenters Road
London E15 2HO

CO *Comsoft*
7 Roman Drive
Leeds
Yorkshire LS8 2DR

CY *Cylindrical Software*
177 College Road
Moseley
Birmingham B13 9LJ

CS *Stable Software*
Compton Street
Compton
Nr Winchester
Hants

CT *Cottage Software*
Heather Cottage
Selly Hill
Whitby
North Yorkshire

CU *Level 9 Computing*
229 Hughenden Road
High Wycombe
Buckinghamshire HP13 5PG

CX *Contex Computing*
15 Woodlands Close
Cople
Bedford MK44 3UE

DA *Davy Computing Ltd*
Moorcroft House
2 Clarence Lane
Sheffield S3 7UZ

DB *Dynabyte Software*
31 Topcliffe Mews
Wide Lane
Morley
Yorks

DC *D.A.C.C. Ltd*
23 Waverly Road
Hindley
Greater Manchester
WN2 3BN

DD *DDT Software*
Southfield House
11 Liverpool Gardens
Worthing
West Sussex BN11 1RY

DK *DK Tronics*
Unit 2
Shire Hill Industrial Estate
Saffron Walden
Essex CB11 3AX

DG *Dialog*
19 Short's Gardens
London WC2H 9AT

DO *Doctor Soft*
258 Coneygree Road
Peterborough
PE2 8LR

DS *Diamondsoft Ltd*
Cheadle Hulme
Cheadle
Cheshire SK8 5YB

DY *Dynatech Microsoft*
Rue du Commerce
Bouet
St. Peter Port
Guernsey C.I.

EB *Ebury Software*
National Magazine House
72 Broadwick Street
London W1V 2BP

EG *SESS Ltd*
Central Trading Estate
275-277 Bath Road
Bristol BS4 3EH

EH *Heinemann*
Computers in Education
22 Bedford Square
London

EJ *Logic Systems*
85 Hemingford Road
Cambridge

EL *ECL Software*
29 Richmond Close
Ware
Herts SG12 0EN

ET *Etna Software*
West End House
West End Lane
Marshchapel Lincs

EU *Educare*
139a Sloane Street
London SW1X 9AY

FB *FBC Systems*
10 Castlefields
Main Centre
Derby

FE *Fernleaf Educational*
Fernleaf House
31 Old Road West
Gravesend
Kent DA11 0LH

FL *Flight Deck Software*
25 Halsey Road
Kempston
Beds. MK42 8AP

FM *4MAT Educational Software*
Linden Lea
Rock Park
Barnstaple
Devon EX32 9AQ

FY *Wida Software*
2 Nicholas Gardens
London W5 5HY

GA *Galaxy Software*
123 Links Drive
Solihull
West Midlands B91 2DJ

GC *Golden Challenge Software*
2-4 Chichester Rents
Chancery Lane
London WC2A 1EG

GD *70 Stoke Road*
Bletchley
Milton Keynes

GE *A&F Software*
83 Hyde Road
Gorton
Manchester M18 7JD

GJ *Computer Concepts*
16 Wayside
Chipperfield
Hertfordshire WD4 9JJ

CONTINUED OVER

SOFTWARE LISTINGS

Title	Type	Manufacturers	Memory		Software Supplier	Price
Disassembler	Ut	Simonsoft	A,B	C	MS	£6.95
Dissassembler	Ut	Micro Power	A,B	C	GK	£5.95
Dissassembler	Ut	Program Direct	A,B	C	NP	£3.00
Dissassembler	Ut	Davansoft	A,B	C	NX	£5.95
Dissassembler	Ut	C J E Microcomputers	A,B	C	NV	£5.00
Disassembler	Ut	A.J.	B	C,D	AJ	£5.95, £7.95
Dis-assembler	Ut	Crystalsoft	A,B	C	CS	£3.50
Discdex	Ut	Clares	B	D	CL	£15.00, £18.00 (3")
Distances	Ed	Micro-Aid	B	C	IZ	£4.95
Dissembler	Ut	Rainbow S/W	A,B	C	KS	£2.50
Digital X-Word Compiler	Gm	N. Darwood	A,B	C	JB	£6.00
Dmon	Ut	Alligata	A,B D , E	C,	AG	£7.95 £11.95, £19.95
Dmove	Ut	FBC Systems	B	C	FB	£12.50
DNA Replication	Ed	Garland Comp.	B	C	JX	£17.65
Dodgy Dealer	Gm	OIC	B	C	OI	£6.50
Dracula Island	Gm	Kansas	B	C	KA	£9.50
Dragon Rider	Gm	Salamander Software	B	C	SA	£7.95
Dragon Quest II	Gm	Bug Byte	B	C	KP	£11.50
Dragon Quest	Gm	Bug Byte	B	C	KP	£11.50
Draughts	Gm	Micro Poer	B	C	GK	£6.95
Draughts/Reversi	Gm	Acornsoft	B,E	C	AL	£9.95, £9.20
Draughts	Gm	Superior	B,E	C	SE	£6.95
Draw	Ut	Micro Power	B,E	C	GK	£9.95
Drawing	Ut	B.B.C.	A,B	C	KB	£10.00
Drawing Pictures and Puzzles	Ed	Ega Beva	B	C	EB	£9.95
Drawstick	Ut	BBC	B	C	KB	£9.95
Drilla Killa	Gm	Vampire Soft	B	C,D	VA	£6.90, £7.90
Drogna	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Dr. Who: The First Adventure	Gm	BBC Pubs	B	C	KB	£10.00
Dumpout 3	Ut	Watford	B	R	WA	£19.00
Dune Rider	Gm	Micro Power	B	C,D	GK	£7.95, £9.95
Dungeon Adventure	Gm	Level 9 Computing	B	C	CU	£9.90
Dynamic Nuclear Magnetic Resonance Spectroscopy	Ed	Microwave	B	C	MW	£3.95
Eagle Empire	Gm	Salamander	B	C	SA	£7.95
Eagle Empire	Gm	Alligata	B	C	SY	£7.95
Early Learning	Ed	B.B.C.	A,B	C	KB	£10.00
Early Numbers	Ed	Bryants S/W	B	C	HW	£4.80
Early Warning	Gm	A&F Software	A,B	C	GE	£6.00
Easycalc	Bs	Zero Software	B	C	AZ	£12.95
Easy Graphics	Ut	Hexagon Software	B	C	HX	£13.50
Easy Junior	Bs	Harrison	B	D	HA	£
Easy Times	Ed	Soft Centre	B	C	SN	£6.00
Easywrite	Ed	System Software	B	C	SY	£10.00
Ecological Simulations	Ed	Garland	B	C	JX	£16.50
E.D.G. Graphics Package	Ut	Salamander	B	C,D	SA	£19.95, £24.95
Edit 7	Ut	Crystalsoft	B	C	CS	£5.00
Ed-master	Ed	R. H. Electronics	B	C	RH	£12.95
Educare's 50	Ed	Educare	A,B	C	EU	£7.95
Education (1)	Ed	Microplus	A,B	C	AM	£4.25
Educational (1)	Ed	Golem	A,B,E	CD	OB	£8.00, £10.00
Educational (2)	Ed	Microplus	A,B	C	AM	£5.25
Educational (2)	Ed	Golem	A,B,E	CD	OB	£8.00, £10.00
Education (3)	Ed	Microplus	B	C	AM	£5.25
Edword	Ed	Clwyd Technics	B	R	CL	£38.95
Egg the Upgrade	Gm	Crystalsoft	B	C	CS	£3.50
Eiffel Tower	Ed	Chalksoft	B	C	CH	£9.25
Einstein's Quanta Simulation	Ed	GSN	B	C,D	GS	£14.00, £15.00
Eldorado Gold	Gm	Micro Power	B	C	GK	£6.95
Electric	Ed	Database Software	A,B	C	NU	£5.50
Electricity	Ed	Primary Programs	B	C	PP	£5.95
Electron-Aid	Ut	Dynabyte	E	C	DB	£6.95
Electronic Colouring Book	Do	Addison-Wesley	B,E	C	AN	£9.95
Elem-add and Elem-sub	Ed	Cottage Soft	B	C	CT	£7.50
Elite	Gm	Acornsoft	B,E	C,D	AL	£12.95 E, £17.65, £14.95
Empire	Gm	Shards	B,E	C	SH	£6.95
English skills I/II	Ed	Griffin	B,E	C	GR	£11.95
Entrepreneur	Gm	Vulcan	B	C	VC	£7.95
Envelope Generator	Ut	System	B	C	SY	£7.00
Equation Balance	Ed	RJE Software	B	C	RJ	£7.95
Eric the Viking	Gm	Mosaic	B	C	MO	£9.95
Escape From Moonbase Alpha	Gm	Program Power	B,E	C	GK	£7.95
Essential French Verbs	Ed	Carsondale	B	C	CD	£11.50
European Studies	Ed	Aztec S/W	B	C	IB	£6.50
Escape from Pulsar 7	Gm	Digital Fantasia	B	C	NT	£8.95
Examiner	Ed	Acornsoft	B	C	AL	£9.95
Exmon	Ut	Beebug	B	CE	BE	£10.00, £23,00
Explorer	Ed	Longman	B	C,D	LM	£9.95, £12.95
Extended Colour Fill Graphics	Ed	Gaelsett Software	B	C	GS	£10.00
Experiments in Artifical Intelligence	Ed	Ganymede Systems	B	C	GY	£9.95
Eye	Ed	Longman	B	C	LM	£14.50
Facemaker	Ed	A.S.K.	B	C	AK	£9.95
Factfile	Ed	Cambridge Micro	B	C,D	CM	£20.08
Factors and Fractions	Ed	Edsoft	B	C,D	ES	£5.95
Fair Share	Ed	Griffin	B,E	C	GR	£9.95
Family Finance	Do	R.H. Electronics	B	C	RH	£12.95
Family Games	Gm	I.J.K. Software	A,B	C	IJ	£4.50
Fantasy Adventure	Gm	Dial	B	C,D	DL	£6.50, £8.00
Fairground	Gm	Superior Software	B	C	SE	£7.95
Fairyland Adventure	Gm	O.K.	B	C	OK	£10.00
Fairytale	Gm	Molimerx	B	C	AJ	£10.06
Fall of Rome	Gm	ASP Software	B	C	AS	£6.99
Feasibility Experiment	Gm	Digital Fantasia	B	C	NT	£10.29
Female Reproductive Cycle	Ed	Garland	B	C	JX	£12.00
Felix and the Fruit Monsters	Gm	Micro Power	B,E	C	GK	£7.95
Felix In The Factory	Gm	Micro Power	B,E	C	GK	£7.95
F For Freddie	Gm	Kansas	B	C	KA	£9.50
Felix Meets the Evil Weevils	Gm	Micro Power	B,E	C,D	GK	£6.95
Fighter Pilot	Gm	Kansas	B	C	KA	£9.50
File Handler	Ut	Dial	B	C,D	DL	£6.50, £8.00
File Plus	Do	Data tap	B	D	DA	£49.95
Finance Pack	Bs	Dial	B	C,D	DL	£4.95, £6.50
Filer	Bs	Micro Power	A,B,E	C	GK	£8.95
Final Accounts Program	Bs	Gemini	B	C,D	GM	£59.95
Firebug	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Firefight	Ed	Highlight	B	C,D	HI	£6.00, £7.00
First Count	Ed	Scholar	B	C,D	SC	£5.00, £7.50
First Steps in Algebra	Ed	Small School	B	C	SM	£6.95
First Steps with Mister Men	Ed	Mirror	B,E	C	MR	£8.95
Firehawks	Gm	Postern	B	C	PT	£6.95
Fishy Business	Gm	Salamander	B	C	SA	£9.95
5 in a row	Ed	Hill MacGibbon	B	C	HM	£6.95
Flint's Gold	Gm	Micrograf	B	C,D	MF	£6.95, £9.95
FIZZ BUZZ	Ed	G.E.D. Software	B	C	GD	£4.50
Fizz Buzz	Ed	Bourne	A,B	C	BO	£4.50
Flags	Ed	IJK Software	B	C	IJ	£4.50
Flags	Ed	Micro-Aid	B	C	IZ	£5.95
Flanders	Ed	Focusplan	A,B	C	FP	£5.95
Fletcher's Castle	Ed	Fernleaf	B	C,D	FE	£9.95, £12.95
Flexibase	Dm, Bs	Alligata	B	C	AG	£9.95, £13.95
Flint's Gold	Gm	Micrograf	B	C,D	MF	£6.95, £9.95
Floater	Ed	Cambridge Micro	B	D	CM	£15.00 + VAT

Flowers of Chrystal	Ed	4MAT	B	C,D	FM	£16.00, £17.65
Flush	Ut	Micro-Aid	A,B	C	IZ	£1.00
Football Pools Predictor	Do	Mayday Software	A,B	C	IX	£4.99
Footer	Gm	Program Power	B	C	GK	£7.95
Forecast	Bs	Acornsoft	B	C	AL	£11.90
Forecasting-single exponential	BS	Micropax	B	C	MP	£4.95
Forecasting-double exponential	Bs	Micropax	B	C	MP	£7.95
Forth	Ut	Aztec	B	C	AZ	£16.85
Forth	Ut	H.C.C.S.	B	C	HC	£34.72
Forth	Ut	Level 9 Computing	A,B	C	CU	£15.00
Forth Toolkit	Ut	Level 9 Computing	B	C	CU	£12.00
FORTH	Ut	Acornsoft	B,E	C	AL	£16.85, £16.10
Four-in-a-Row	Gm	Dial	B	C,D	DL	£4.95, £6.50
Frac Attack	Ed	Shards	B	C,D	SH	£6.95, £9.95
Fraction Chase	Ed	GED Software	B	C	GD	£4.00
Fractions	Ed	Garland	B	C	JX	£7
Fracts	Ed	Cottage Soft	B	C	CT	£7.50
Franklins Tomb	Gm	Salamander	B	C	SA	£9.95
Freefall	Gm	Acornsoft	B,E	C	AL	£9.95, £9.20
French Connections	Ed	Cambridge Micro	B	C,D	CM	£15.00 + VAT
French Vocabulary	Ed	Dial	B	C	DL	£8.50
French Irregular Verbs	Ed	Carsondale	B	C	CD	£18.86
French Mistress A/B	Ed	Kosmos	B,E	C	KM	£9.95
French Vocabulary	Ed	Hargreaves	B	C	HG	£6.50
French Text Fill	Ed	Carsondale	B	C	CD	£9.95
French Tutor	Ed	Salamander	B,E	C	SA	£9.95
Fractions Illustrated-1	Ed	RJE Software	B	C	RJ	£5.95
Fractions Illustrated-2	Ed	RJE Software	B	C	RJ	£5.95
Frak	Gm	Aardvark	B	C	AR	£8.95
French Abroad	Ed	Micro-Aid	B	C	IZ	£7.95
Frenzy	Gm	Persoft	A,B	C	IY	£5.75
Frenzy	Gm	Micro Power	B	C	GK	£7.95
Friend or Foe	Ed	Hill MacGibbon	B	C	HM	£6.95
Froggy	Gm	Superior	B	C	SE	£7.95
Frogjump	Gm	Sapphire	B	C	SH	£5.95
Frogger (Machine Code)	Gm	A&F Software	B	C	GE	£8.00
Froglet	Gm	ASP Software	B,E	C	AS	£6.99
Fruit Machine	Gm	Superior Software	B,E	C	SE	£7.95
Fruit Machine	Gm	Bug Byte	B	C	KP	£5.50
Fruit Machine	Gm	Alligata	B,E	C	AG	£5.95
Fruit Machine	Gm	Computersmith	B	C	LC	£5.50
Fruit Machine + Honest Joe	Gm	Beebug	B	C	BE	£7.50
Fruity	Gm	Odyssey	B	C	OG	£3.00
Fun House	Ed	Clares	B	D	CL	£10.00, £13.00 (3")
Fun to Learn	Ed	Shards Soft	B	C,D	SH	£6.95, £9.95
Fun Pack	Gm	Sapphire	B	C	SH	£5.95
Fun plot	Ed	Edsoft	B	C	ES	£5.95
Fun Sums	Ed	Kosmos	A,B	C	KM	£4.95
Fun with Numbers	Ed	Golem	B,E	C,D	OB	£8.00, £10.00
Fund With Sorting	Ed	Golem	B,E	C,D	OB	£7.95, £9.95
Fun with Words	Ed	Golem	B,E	C,D	OB	£8.00, £10.00
Fun Games	Gm	B.B.C.	A,B	C	KB	£10.00
Galactic Commander	Gm	Micro Power	B,E	C	GK	£6.95
Galactic Firebird	Gm	Kansas	B	C	KA	£9.50
Galactic Wipeout	Gm	R. H. Electronics	B	C	RH	£8.95
Galaxy Birds	Gm	Superior	B	C	SE	£7.95
Galaxy Wars	Gm	Bug-Byte	B	C	BB	£7.50
Galaxy's Edge	Gm	Magic	B	C	MG	£7.45
Game Core	Ut	BBC	B	C	KB	£10.95
Games Compendium B1/2	Gm	Salamandar	B	C	SA	£6.95
Games Pack 1/2	Gm	Processor Applications	B	C	AP	£5.95
Games Pack 1	Gm	Computersmith	B	C	LC	£5.50
Games Tape 1	Gm	Pro Software	A,B	C	SP	£7.95
Games Pack 1	Gm	Computersmith	A,B	C	LC	£5.50
Games of Deduction 1-4	Ed	Fernleaf	B	C,D	FE	£35.95
Gamemaker	Ut	Holly	E	C	HO	£12.99
Game of Logic	Ed	N. Darwood	A,B	C	JB	£8.00
Games of Logic	Gm	Golem	A,B,	C,D	B	£4.95, £6.95

SOFTWARE SUPPLIERS

GK Micro Power Ltd
Northwood House
North Street
Leeds LS7 2AA

GM Gemini
9 Salterton Road
Exmouth
Devon EX8 2BR

GN Gnomonica
2 Stable Cottages
Pleystowe, Rusper Rd
Capel, Dorking
Surrey RH5 5HE

GR Griffin Software
285 Ealing Road
Alperton
Wembley
Middlesex
HA0 1HJ

GS Gaelsett Software
44 Exeter Close
Stevenage
Herts
SG1 4PW

GY Huntsman Walk
Rugeley
Staffs WS15 2SN

HA Harrison Associates
Unit 307
16 Brune St
London E1 7NJ

HC H.C.C.S. Associates
533 Durham Road
Low Fell
Gateshead
Tyne and Wear NE9 5EY

HE Heinemann Computers in Education
Freepost EM17
The Windmill Press
Kingswood
Tadworth
Surrey KT20 6BR

HG J Hargreaves
Updown
Pewley Way
Guildford
Surrey

HH H&H Software
53 Holloway
Runcorn
Cheshire WA7 4TJ

HM Harris McCutcheon Systems
40Huntingdon Street
London N1 1HM

HN Hutchinson
17-21 Conway Road
London W1P 6JD

HO Holly Computers
PO Box 17
Bingley
W.Yorkshire
BD16 3JQ

HW Bryants (Educational) Software
1 The Hollies
Chalcraft Lane
North Bersted
Bognor Regis PO21 5SX

HX Hexagon Software
17 Straits Road
Gornal
Dudley
West Midlands
DY3 2UR

HY Honeyfold Software
Standfast House
Bath Place, High St.
Barnet
London EN5 1ED

IB Aztec Software
25 St Mark Road
Deepcar
Sheffield
S30 5TS

IC Ian Copestake
23 Connaught Crescent
Brookwood
Woking
Surrey
GU24 0AN

IF Electronics Applied
4 Dromore Road
Carrickfergus
County Antrim BT38 7PJ

IJ I J K Software
9 King Street
Blackpool
Lancs

IN Ixion Software
10 The Crescent
Lympsham
Weston-Super-Mare
Somerset BS24 0BN

IO Icon Software
65 High Street
Gosforth
Tyne & Wear NE3 4AA

IS Software Invasion
50 Elborough Street
Southfields
London

IU Aardvark Software
15 Queensberry Avenue
Hartlepool
Cleveland TS26 9NW

IV James Hager
7 Basset Street
Camborne
Cornwall TR14 8SW

HS Simon Hessel Software
15 Lytham Court
Cardwell Crescent
Bershire

IX Mayday Software
181 Portland Crescent
Stanmore
Middlesex HA7 1LR

IY Persoft
Freepost
Baildon
Shipley
West Yorkshire BD17 5SX

IZ Micro Aid
25 Fore Street
Praze Camborne
Cornwall TR14 0JX

JL Joe the Lion
213/215 Market Street
Hyde
Cheshire
SK14 1HF

JS J.B. Software
57 Meadow Crescent
Carleton
Poulton-le Fylde
Lancashire
FY6 7QX

CONTINUED OVER

SOFTWARE LISTINGS

Title	Type	Manufacturers	Memory		Software Supplier	Price
Games of Strategy	Gm	B.B.C.	A,B	C	KB	£10.00
Games Pack II	Gm	Micromail	B	C	OE	£6.75
Gauntlet	Gm	Micro Power	E	C	GK	£6.95
Gateway to Karos	Gm	Acornsoft	B	C	AL	£9.95
G.B. Geography	Ed	Primasoft	B	C	PR	£6.95
GCE Maths (O) 1/2	Ed	Bryants	A,B	C	HW	£9.50
Genetic Code	Ed	Garland Comp.	B	C	JX	£17.65
Geography Map	Ed	Bryants	B	C	HW	£4.85
Geography France/Spain/Germany/Italy/Belgium/USA/India	Ed	Corona	B	C,D	JY	£6.00, £9.00
German Irregular Verbs	Ed	Carsondale	B	C	CD	£13.80
German Master	Ed	Kosmos	B,E	C	KM	£9.95
Get it Right	Ed	Sulis	B	C	SU	£9.95
Get Set	Ed	Griffin	B,E	C	GR	£9.95
Get the Message	Gm	Dial	B	C,D	DL	£4.95, £6.50
Ghost/Diamonds	Gm	A Lane	A,B	C	OC	£3.00
Ghost Maze	GM	Software for All	B	C	HN	£6.95
Ghost Town	Gm	Adventure International	B,E	C	AI	£7.95
Ghouls	Gm	Micro Power	B	C	GK	£7.95
Gideon's Gamble	Gm	Superior Software	B	C	SE	£7.95
Glooper	Gm	Microplus	B	C	AM	£6.95
Glycolysis – TCA Cycle	Ed	Garland	B	C	JX	£15.00
Gnasher	Gm	Superior	B	C	SE	£6.95
Gobbler	Gm	M G B	B	C	MG	£5.45
Golden Voyage	Gm	Adventure International	B,E	C	AI	£7.95
Golf	Gm	Microplus	B	C	AM	£4.95
Golf	Gm	Computersmith	B	C	LC	£5.50
Golforama	Gm	Dial	B	C,D	DL	£4.95, £6.50
Grand Prix	Gm	Software for All	B	C	HN	£5.95
Grand Prix	Gm	Microplus	A,B	C	AM	£4.25
Granny's Garden	Ed	4MAT	B	C,D	FM	£10.00, £12.00
Graph Capers Senior	Ed	Gem	B	C	GM	£8.50
Graphs	Ed	Bryants	A,B	C	HW	£4.85
Graphics Aid Pack	Ed	Microwave NW	B	C	MW	£8.95
Graphito	Ut	Addison-Wesley	B	C	AN	£21.95 + VAT
Grafix	Ut	Williams	B	D	WI	£10.00
Golf	Gm	Bryants S/W	B	C	HW	£4.88
Golf	Gm	Bug Byte	B	C	BB	£7.00
Golf	Gm	Computersmith	B	C	LC	£5.50
Gomoku	Gm	Micro Power	A,B	C	GK	£3.95
Graphics Package	Ut	Salamander Software	B	C	NZ	£24.95
Graph and Charts Pack	Bs	Acornsoft	B,E	C	AL	£9.95, £9.20
Graphics Pack	Ut	Bug-Byte	B	C	BB	£9.50
Graphs (Arithmetical)	Ed	Bryants	B	C	HW	£4.85
Great Britain Ltd	Gm	Hessel	B	C	HS	£5.95
Greater and Smaller	Ed	Scholar	B	C,D	SC	£6.50, £8.50
Grig Blitz	Gm	Computercat	B	C	CC	£5.95
Group Statistics	Bs	Micropax	B	C	MP	£7.95
Guardian	Gm	Alligata	E	C	SY	£7.95
Guided Discovery	Ed	Etna Software	B	C	ET	£9.95
Gunsmoke	Gm	Software Invasion	B	C	IS	£7.95
Guzzler	Gm	Computersmith	B	C	LC	£5.50
Handwriting 1/2	Ed	Chalksoft	B	C	CH	£9.95
Hangdroid	Gm	Micromode	B	C	MO	£4.00
Hangman	Ed	Micro Aid	B	C	IZ	£7.95
Hangman Player	Ed	Square	A,B	C	SQ	£7.00
Hangman	Gm	Micro Aid	B	C	IZ	£7.95
Hangman	Gm	Aztec S/W	A,B	C	IB	£5.50
Hangman	Gm	MP S/W	B	C	JZ	£4.00
Happy Letters	Ed	Bourne	B,E	C,D	BO	£8.97, £10.98
Happy Numbers	Ed	Bourne	B,E	C,D	BO	£8.97, £10.98
Harlequin	Ed	LTS	B	D	LT	£14.95
Harlequin	Ed	LTS	B	D	LT	£14.95
Harmony	Ut	Doctor Soft	B	C	DS	£6.95
Headway	Ed	GSN	B	C,D	GS	£200.00
Heist	Gm	Softspot	B	C	SF	£6.95
Helicopter Rescue/Tunnel/ Hi-VIEW	Gm	A Lane	A,B	C	OC	£4.00
Henry IV Part 1	Ln	Acornsoft	B	D	AL	£59.80
Roadrace	Ed	Penguin	B,E	C	PE	£5.95
Hell Driver	Gm	Micro Power	B,E	C	GK	£7.95
Hi-Bouncer	Gm	Mirrorsoft	B	C,D	MR	£6.95, £9.95
Hide and Seek	Ed	A.S.K	B	C	AK	£9.95
History Quiz	Do	Acornsoft	B,E	C	AK	£12.65
Hitch Hiker	Gm	Computer Concepts	B	C	GJ	£7.80
Home Accounts	Bs	Harris	B	D	HM	£28.75
Home Accounts	Do	BJ Software	B	C	BJ	£6.00
Home Accounts	Do	Diamondsoft	B	C	DS	£14.95
Home Accounts	Bs	Gemini	B	C	GM	£19.95
Home Accounts	Do	Persoft	B	C	IY	£12.50
Home Accounts	Do	BJ Software	B	C	BJ	£6.00
Home Filewriter	Do	Dynatech	B	D	DY	£39.95
Home Finance	Do	B.B.C.	A,B	C	KB	£10.00
Hooked on Numbers	Ed	Acornsoft	B	C	AL	£9.95
Hoop-La	Ed	Soft Centre	B	C	SN	£6.00
Hopper	Gm	Acornsoft	B,E	C,R	AL	£9.95, £9.20
Horror Castle	Gm	A&F	B	C	GE	£8.00
Horserace	Gm	Dynabyte	B,E	C	DB	£6.95
Hot Cakes	Ed	Private Tutor	B	C,D	PT	£7.95, £8.95
Housekeeper	Ed	Heinemann	B	C	HE	£9.25 + VAT
Howszat	Gm	A&F	B	C	GE	£6.90
Human Blood Groups	Ed	Garland	B	C	JX	£15
Hunchback	Gm	Superior Software	B	C	SE	£7.95
Hydraulics	Ed	Database Software	A,B	C	NU	£5.50
Hyperdrive	Gm	IJK	B	C	IT	£6.50
Identikit	Ed	Stell	B,E	C	ST	£7.95
'...I Do'	Do	Acornsoft	B	C	AL	£12.65
Indentikit/Word Finder	Ed	Heinemann	B	C	HE	£9.25 + VAT
Index	Ut	Microwave NW	B	C	MW	£6.95
Index Numbers-Basket	Bs	Micropax	B	C	MP	£7.95
Index Numbers-Changer	Bs	Micropax	B	C	MP	£7.95
Indexit	Ut	Williams	B	D	WI	£10.00
Inhabitant	Ed	Longman	B	C,D	LM	£9.95, £12.95
Inheritance	Gm	S.W. Hessel S/W	B	C	IW	£5.95
Inheritance	Ed	Garland Comp.	B	C	JX	£34.70
Inkosi	Gm	Chalksoft	B	C	KT	£5.95
Intergalactic Trader	Gm	Micro Power	B,E	C	GK	£8.95
International Special Agent	Gm	O.K.	B	C	OK	£10.00
Intervention commercial	Bs	System	B	C	SY	£345.00
Intervention educational	Ed	System	B	C	SY	£115.00
In the Grip of Ice	Gm	O.K.	B	C	OK	£10.00
Intro	Ed	Clares	A,B	C	CL	£7.95
Introducing Map Skills 1/2	Ed	Cambridge Micro	B	C,D	CM	£13.95, £1.62
Introduction to Microcomputing in Teaching	Ed	Hutchinson	B	C	HN	£17.25
Invaders	Gm	Software Invasion	B	C	IS	£6.95
Invaders	Gm	Superior Software	B	C	SE	£7.95
Invaders	Gm	Software for All	A,B	C	KN	£6.95
Invaders	Gm	Hexagon S/W	A,B	C	JA	£6.00
Invasion	Gm	ASP Software	B,E	C	AS	£6.99
Invisible Man	Ed	Chalksoft	B	C	KT	£5.95
Invoicing	Bs	Acornsoft	B	D	AL	£24.95
Invoices and Statements	Bs	Gemini	B	C	GM	£19.95
ISO-Pascal	Ln	Acornsoft	B	R	AL	£69.00
Janeplus	Ed	Longman	B	C	LM	£14.50
Jars	Ed	Acornsoft	B	C	AL,	£11.90
JCB Digger	Gm	Acornsoft	B	C	AL	£9.95, £11.50
Jet Power Pack	Gm	Micro Power	B	C	GK	£7.95
Jigsaw Puzzle	Ed	Ega Beva	B	C	EB	£9.95

Jigsaw & Sliding Puzzles	Ed	Golem	B,E	C,D	OB	£7.95, £9.95
Johnny Reb	Gm	Lothlorien	B	C	LO	£6.95
J.R.	Gm	Software for All	B	C	KN	£6.95
Julius Caesar	Ed	Penguin	B,E	C	PE	£5.95
Jumbles	Ed	Bryants S/W	B	C	HW	£4.88
Jumbo	Gm	Molimerx	B	C	AJ	£17.25
Jungle Ambush	Gm	Kindsoft	B	C	KU	£6.50
Jungle Journey	Ed	Trekkasoft	B	C	TR	£5.50
Junior Maths	Ed	Aztec	A,B	C	AZ	£3.00
Junior Maths Pack	Ed	Micro Power	B	C	GK	£6.95
Junior Word Splits	Ed	Sulis	B	C	SU	£9.95
Just a Mot	Ed	Sulis	B	C	SU	£9.95
Kamikaze	Gm	A&F	E	C	GE	£7.90
Keeping Myself Alive	Ed	Heinemann	B	C	HE	£9.25 + VAT
Katakombs	Gm	Golem	B	C,D	OB	£5.95, £7.95
Keyrecog	Ed	Ed. Soft	B	C	ES	£4.95
Kidney	Ed	Garland	B	C	JX	£12
Kingdom of Hamil	Gm	Acornsoft	B	C	AL	£9.95
Killer Gorilla	Gm	Micro Power	B,E	C	GK	£7.95
Knowledge Quest	Ed	Pee Bee	B	C,D	PB	£10.95, £14.45
Konexion	Gm	M and M Software	A,B	C	MM	£5
Kopfjäger	Ed	Cambridge Micro	B	D	CM	£15.00 + VAT
Kremlin	Gm	Doctor Soft	B	C	DO	£6.95
Kubla Khan	Gm	Blue Moon	B	C	BM	£8.95
L	Ed	ATM	B	D	AT	£10.00
Labdis	Ut	Silversoft	B	C	SV	£6.95
Labyrinths of La Coshe	Gm	Micro Power	B	C	GK	£7.95
Ladder Maze	Gm	Superior	B	C	SE	£6.95
Landfall	Gm	Virgin Games	B	C	VG	£7.95
Language Development Pack	Ed	LTS	B	C,D	LT	£12.95
Language Development Pack	Ed	LTS	B	C,D	LT	£12.95
Language Tutor	Ed	Rainbow Research	B	C	RR	£5.00
La Princesse (French)	Ed	Aztec S/W	B	C	IB	£6.50
Language-Lab	Ed	M and M Software	A,B	C	MM	£7.50
Landfall & Serpent	Gm	GT Software	B	C	JW	£6.50
Laser Command	Gm	Micro Power	B,E	C	GK	£7.95
Laser Letters	Ed	Shards	B	C,D	SH	£6.95, £9.95
Laser Probe	Ed	Hill MacGibbon	B	C	HM	£6.95
Laser Zone	Gm	Salamander	B	C	SA	£7.95
Las Vegas	Gm	R.H. Electronics	B	C	RH	£8.95
Launching Logic	Ed	Shiva	B	C	SV	£14.95
Learn Addition	Ed	ABC Primary	B	C	AB	£6.50
Learn Subtraction	Ed	ABC Primary	B	C	AB	£6.50
Leap Frog	Gm	IJK Software	B	C	IJ	£7.50
Learning Compendium I	Ed	Ega Beva	B	C	EB	£11.95
Learning Compendium II	Ed	Ega Beva	B	C	EB	£9.95
Ledger	Bs	Micro Aid	B	C	IZ	£7.95
Legion	Gm	Software Projects	B	C	SW	£7.95
Letters	Ed	Chalksoft	B	C	CH	£6.95
Let's Count	Ed	A.S.K	B	C	AK	£9.95
Letterbugs	Ed	Highlight	B	C,D	HI	£6.00, £7.00
Librarian/Word Finder	Ed	Heinemann	B	C	HE	£9.25 + VAT
Library Classification	Ut	Aztec	A,B	C	AZ	£6.50
Library Dewey Classification	Ed	Aztec S/W	B	C	IB	£6.50
Life	Gm	Ixion	A,B	C	IN	£4.75
Life Plus	Gm	Mayday	A,B	C	IX	£4.49
Lift	Ed	Cambridge Micro	B	D	CM	£15.00 + VAT
Lift off with Numbers	Ed	Shiva	B	C	SV	£14.95
Lightpen Colourgraphic	Ut	R.H. Electronics	B	C	RH	£9.95
Linear Programming	Bs	Micropax	B	C	MP	£12.95
Linear Regression, Correlation	BS	Micorpax	B	C	MP	£7.95
Lines and Angles	Ed	4MAT	B	C	FM	£5
Link-4-Plus	Gm	ABC Software	A,B	C	KR	£6.95
LINKWORD French, German, Spanish	Ed	Acornsoft	B	C	AL	£14.95
Lisp	Ut	Acornsoft	B,E	C,R	AL,	£16.85, £16.10
Lisp	Ut	Aztec	B	C	AZ	£16.85
LISP Demonstrations	Ut	Acornsoft	B	C,D	AL	£9.95, £11.50
Logo-Forth	Ut	H.C.C.S.	A,B	E	HC	£59.00
Logo 2	Ut	Computer Concepts	B	C	GJ	£10.00
Longitudinal Waves	Ed	Heinemann	B	C	EH	£12.50

SOFTWARE SUPPLIERS

KA *Kansas City Systems*
Unit 3
Sutton Springs Wood
Chesterfield S44 5XF

KB *BBC Publications*
British Broadcasting Corporation
35 Marylebone High Street
London W1M 4AA

KF *Kingfisher Computer Services*
Durley Lane
Keynsham
Bristol BS18 2AQ

KH *Superior Software*
69 Leeds Road
Bramhope
Leeds

KM *Kosmos*
1 Pilgrims Close
Harlington
Dunstable
Bedfordshire
LU5 6LX

KN *Software for All*
72 North Street
Romford
Essex

KS *K. A. Spencer*
74 Dovers Park
Bathford
Nr Bath
Avon

KU *Kudusoft*
130 Main Street
Tweedmouth
Berwick-upon-Tweed
TD15 2AW

LA *Ludinski Computer-Assisted Learning*
24 Avondale Avenue
Staines
Middlesex

LC *Computersmith*
40 Greenfields Avenue
Bromborough
Wirral
Merseyside L62 6DD

LM *Longman Group*
Longman House
Burnt Mill
Harlow
Essex

LO *Lothlorien*
56a Park Lane
Poynton
Cheshire SK12 1AE

MA *MP Software and Services*
165 Spital Road
Bromborough
Merseyside L62 2AE

MB *Microbyte Software*
Freepost
Newquay TR7 2BR

MD *MED*
640 Melton Road
Thurmaston
Leics

MI *Microgame Simulations*
73 The Broadway
Grantchester
Cambridge
CB3 9NQ

MG *MGB Software Support*
52 Barley Croft
Harlow
Essex

MK *David McKeran*
23 Warwick Drive
East Herrington
Sunderland
Tyne and Wear

MM *M and M Software*
1391 Leek Road
Abbey Hulton
Stoke-on-Trent
Staffs ST2 8BW

MN *Merlin Computer Products*
18 Mansel Street
Swansea SA1 5SG

MO *Micromode*
32 West End Avenue
Gatley
Cheshire

MO *Molimerx Ltd*
1 Buckhurst Road
Town Hall Square
Bexhill-on-sea
East Sussex

MR *MRM Software*
17 Cross Coates Road
Grimsby
South Humberside

MS *Musicsoft*
12 Fallowfield
Ampthill
Beds

MW *Microwave NW*
24 Belford Road
Stretford
Manchester M32 0DL

OI OIC Ltd
15 Burglead Close
College Town
Camberley
Surrey GU15 4XL

OP *Optima Software Ltd*
36 St. Petersgate
Stockport SK1 1HL

OT *Oxhey Tutors*
19 Tudor Walk
Watford
Herts. WD2 4NY

PB Pee Bee Software
PO Box 175
High Wycombe
Bucks.

PU Pumpkin Programs
35 Hammerfield Avenue
Aberdeen AB1 6LL

SA *Salamander Software*
17 Norfolk Road
Brighton
East Sussex
BN1 4AA

SC *Scholar Soft*
Coniseliffe
Woolsington Gdns
Woolsington
Newcastle Upon Tyne
NE13 8AP

SC *Screenplay*
134 St. Vincent Street
Glasgow

SC *Starcade*
2 Elworthy Avenue
Liverpool L26 7AA

CONTINUED OVER

SOFTWARE LISTINGS

Title	Type	Manufacturers	Memory		Software Supplier	Price
Looking at Graphs	Ed	Heinemann	B	C	HE	£9.25 + VAT
Looking at Scales	Ed	Heinemann	B	C	HE	£9.25 + VAT
Look it up	Ed	GED Software	B	C	GD	£4.50
Look Sharp!	Ed	Mirror	B,E	C	MR	£7.95
LOGO	Ln	Acornsoft	B	R	AL	£69.00
Logo Challenge	Ed	Addison-Wesley	B	C,D	AN	£29.95, £37.95
Lorry/Farm	Ed	Primary	B	C,D	PP	£5.95, £7.95
Lords of Time	Gm	Level 9	B	C	CU	£9.90
Lost City	Gm	Superior Software	B	C	SE	£7.95
Lost In Space	Gm	Salamander	B	C	SA	£9.95
Lunar Rescue	Gm	Alligata	B	C	AG	£7.95
L Trap	Gm	Gem	B	C	GM	£8.50
Lunar Lander	Gm	A&F Software	B	C	GE	£6.90
Macbeth	Ed	Penguin	B,E	C	PE	£5.95
Mach 1	Ut	Gnomonica	B	E	GN	£39.95
Magic Adventure	Gm	Kansas	B	C	KA	£8.50
Mailer	Ut	ASD Ltd	B	C	AS	£5.75
Mailing List	Bs	Gemini	B	C	GM	£19.95
Mailing	Bs	Micro-Aid	A,B	C	IZ	£7.95
Mailing System	Bs	Acornsoft	B	D	AL	£24.95
Map Rally	Ed	Bourne	B,E	CD	BO	£8.97, £10.98
Making Ends Meet	Ed	Cambridge Micro	B	C,D	CM	£15.00 + VAT
Manage	Gm	Cases	B	C	CE	£6.95
Mansion Murders	Gm	Challenge Games	B	C	CG	£6.95
Mapping Skills	Ed	Heinemann	B	C	HE	£9.25 + VAT
Mark Book	Ed	Carvells	A,B	C	CA	£5
Mark Book	Ed	BBC	A,B	C	KB	£15
Martian Attack	Gm	Micropower	B	C		£7.95
Mass	Ut	DDT	B	R	DT	£34.95
Masterbard Hamlet	Ed	Sulis	B	C	SU	£12.95
Master Copier	Ut	Aztec S/W	A,B	C	IB	£6.50
Masterfile	Ut	Beebug	B	CD	BE	£10.00, £19.00
Mastermind	Gm	Micro Power	A,B	C	GK	£3.95
Matchup	Ed	Edsoft	B	C	ES	£5.95
Mathgrid	Ed	Soft Centre	B	C,D	SN	£8.00, £10.00
Maths Invaders	Ed	Stell	B,E	C	ST	£7.95
Mathskills I/II	Ed	Griffin	B,E	C	GR	£11.95
Maths Man	Ed	GED Software	B	C	GD	£4.00
Maths Pack	Ed	Ega Beva	B	C	EB	£11.95
Maths Pack	Ed	Dial	B	C,D	DL	£4.95, £6.50
Maths Topics 1	Ed	Cambridge Micro	B	C,D	CM	£13.95 + VAT
Maths Topics 2	Ed	Cambridge Micro	B	C,D		£15.00 + VAT
Mathspell	Ed	Diamondsoft	B	C	DS	£7.95
Maths Topics 1	Ed	CUP	B	C	UP	£18
Maths Translation	Ed	Corona S/W	B	C	JY	£6.00
Maths Tutors, Graphs	Ed	Salamander	B,E	C	SA	£9.95
Maths Tutors, Vectors	Ed	Salamander	B,E	C	SA	£14.95
Matching	Ed	Clares	A,B	C	CL	£5.95
Maze	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Matrices	Ed	Chaddington	B,E	C,D	CN	£10.00
Maze Invaders	Gm	Micro Power	B	C	GK	£4.95
Maze Man	Gm	C J E Microcomputers	B	C	NV	£6.00
Micro Budget	Do	Micro Power	A,B	C	GK	£6.95
Meditor	Ut	MED	B	C	MD	£9.50
Medmon	Ut	MED	A,B	C	MD	£9.95
Membership Manager	Do	Acornsoft	B	C	AL	£9.95
Memocalc	Bs	Microaid	B	C	IZ	£9.95
Mental Arithmetic Tests	Ed	Small School	B	C	SM	£6.95
Mental Maths and Place Value	Ed	Edsoft	B	C,D	ES	£4.95
Merchant of Venice	Ed	Penguin	B,E	C	PE	£5.95
Mercy Mission to Mars	Gm	D.A.C.C.	B	C	DC	£5.95
Merlins Castle	Ed	Pumpkin	B	C	PU	£5.00
Meteor Mission	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Meteor Mission	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Meteors	Gm	Acornsoft	B,E	C	AL	£9.95
Metrics (5)	Ed	Chalksoft	B	C	KT	£9.95
Microbial Pop. Dynamics	Ed	Microwave NW	B	C	MW	£7.00
Microbug	Ed	Arnold-Wheaton	B	C,D	SY SW	£15.00 + VAT
Micro Man	Gm	Pro S/W	B	C	LD	£8.00
Micro Maths	Ed	LCL	A,B,E	C,D	KA	£24.50
Micros in Classroom 1-5	Ed	Longman	B	C,D	LM	£20.00 each
Milikan's Oil Drop	Ed	GSN	B	C,D	GS	£14.00, £15.00
Micromon	Ut	Molimerx	B	C,R	MO	£14.00, £28.00 + VAT
Middle Kingdom	Gm	Pro Software	A,B	C		£7.95
Microtext	BS	Acornsoft	B	C	AL	£49.85
Microtype	Ed	Kansas	B	C	KA	£12.50
Micros in Maths Classroom	Ed	Longman	B	C,D	LM	£26.00 + VAT
Millionaire	Gm	Incentive Software	B,E	C	IN	£6.50
Million Mazes	Gm	Ludinski	B,E	C	KA	£6.50
Mined Out	Gm	Quicksilva	B	C	QS	£6.95
Miner	Gm	Ixion	B	C	IN	£6.90
Minefield	Gm	Eduquest	A,B	C	NW	£5.95
Minefield	Gm	A&F Software	A,B	C	GE	£6.00
Missile Base	Gm	Acornsoft	B	C	AL,	£9.95
Missile Control	Gm	C J E Microcomputers	B	C	NV	£9.00
Missile Control	Gm	Gemini	B	C	GM	£9.95
Missing Signs	Ed	Acornsoft	A,B	C	AL	£11.90
Missile Strike	Gm	Superior	B	C	SE	£7.95
Missing Length	Ed	Scholar	B	C,D	SC	£6.50, £8.50
Mission Impossible	Gm	Aztec S/W	A,B	C	IB	£6.50
Mitosis	Ed	Garland	B	C	JX	£15
Mixed Games	Gm	I.J.K. S/W	A,B	C	IT	£3.95
MMaths	Ed	Ed. Soft	B	C	ES	£4.95
Model A Invaders	Gm	I.J.K. S/W	A,B	C	IT	£4.95
Model B Invaders	Gm	I.J.K. S/W	B	C	IT	£6.95
Moli-Tool	Ut	Molimerx	B	R	MO	£28.00 + VAT
Moments + Van	Ed	RJE Software	B	C	RJ	£4.95
Monaco	Gm	Alligata	B	C	SY	£7.95
Money Box	Ed	Bryants	A,B	C	HW	£4.85
Moneyplus 1-4	Ed	Fernleaf	B	C,D	FE	£35.95
Monster Maths	Ed	Shards	B	C,D	SH	£6.95, £9.95
Monster Maze	Ed	Kingfisher	A,B	C	KF	£6.90
Monsters	Gm	Acornsoft	B,E	C	AL	£9.95, £9.20
Monsters and Giants	Ed	Longman	B	C,D	LM	£9.95, £12.95
Monster Battles	Gm	Bryants S/W	B	C	HW	£4.80
Moon Mission	Gm	Superior	B	C	SE	£7.95
Moon Raider	Gm	Micro Power	B,E	C	GK	£7.95
Morse Code	Ed	Philip Dodderidge	B	C	PD	£6.50
Morse Code Fun	Ed	Aztec	A,B	C	AZ	£3.00
Moving Molecules	Ed	C.U.P	B	C	CP	£13.95
Mr EE	Gm	Micro Power	B	C,D	GK	£6.95
Mr T's Alphabet Games	Ed	Ebury	B	C	EB	£9.95
Mt T's Measuring Games	Ed	Ebury	B	C	EB	£9.95
Mr T's Money Box	Ed	Ebury	B	C	EB	£9.95
Mr T's Number Games	Ed	Ebury	B	C	EB	£9.95
Mr T's Shape Games	Ed	Ebury	B	C	EB	£9.95
Mr T Tells The Time	Ed	Ebury	B	C	EB	£9.95
Mr T Makes Music	Ed	Ebury	B,C	C	EB	£9.95
Mr T Meets His Match	Ed	Ebury	B	C	EB	£9.95
Mr T's Simple Sums	Ed	Ebury	B	C	EB	£9.95
Mr Wiz	Gm	Superior	B,E	C	SE	£7.95
Multi-Aid	Ut	Dynabyte	A,B	C	DB	£7.95
Multifile	Bs	Bug Byte	A,B	C	BB	£25.00
Multiforth 83	Ut	Skyware	B	R	SK	£40.00 + VAT
Multiple Choice	Ed	Eduquest	B	C	NW	£25.00
Multiple Choice Maths O 1/2	Ed	Chaddington	B,E	C,D	CN	£12.00

Multiple Slit Interference	Ed	GSN	B	C,D	GS	£14.00, £15.00
Multiply and Divide	Ed	Cottage Soft	A,B	C	CT	£7.50
Multitest	Ed	System	B	C,D	SY	£14.95
Munchyman	Gm	Micro Power	A,B	C	GK	£5.95
Music Tutor	Ed	Ed. Soft	B	C	ES	£9.95
Music	Do	B.B.C.	A,B	C	KB	£10.00
Music Editor	Ed	System	B	C	SY	£9.00
Music Maker	Gm	Rainbow S/W	A,B	C	KS	£3.50
Music Synthesiser	Ut	Bug-Byte	B	C	BB	£9.50
Music Master	Ed	Merlin	B	C	MN	£6.95
Music Processor	Gm	Quicksilva	A,B	C	QS	£14.95
Music Quiz	Do	Acornsoft	B	C	AL	£12.65
Musictools 1	Ut	Musicsoft	B	C	MS	£5.75
Musical Numbers	Ed	Bryants S/W	B	C	HW	£4.88
Musical Number Box	Gm	Bryants S/W	A,B	C	HW	£3.75
Mutant Invaders	Gm	I.J.K. S/W	A,B	C	IT	£5.95
Mutant Spiders	Gm	Superior	B	C	SE	£6.95
MX 80 Type 3 Screen Dump	Ut	Software for All	A,B	C	KN	£6.95
My Mathematical Self	Ed	Heinemann	B	C	HE	£9.25 + VAT
Mystery of the Jowa Star	Gm	Shards	B,E	C	SH	£7.95
1984	Gm	Incentive	B	C	IV	£6.95
1914	Ed	Cambridge Micro	B	C,D	CM	£15.00 + VAT
Nominal Ledger	Bs	Micropower	B	C	GK	£7.99
Note Invaders Package	Ed	Chalksoft	B	C	CH	£9.25
Number Balance	Ed	Acornsoft	A,B	C	AL, GA	£11.90
Networks-Basic	Bs	Micropax	B	C	MP	£12.95
Networks-Pert.	Bs	Micropax	B	C	MP	£17.95
Networks-Big Part	Bs	Micropax	B	D	MP	£75.00
Nightmare Maze	Gm	MRM	B,E	C	MR	£5.70
Nightmare Maze	Gm	MRM	B,E	C	MR	£5.70
Number Bond	Ed	Primary Programs	B	C	PP	£3.95
Number Chaser	ED	A.S.K	B	C	AK	£9.95
Number Fun	Ed	Griffin	B	C	GR	£9.95
Number Lang	Ed	Dial	B	C,D	DL	£4.95, £6.50
Number Puzzler	Ed	A.S.K	B	C	AK	£9.95
Number Gulper	Ed	A.S.K	B	C	AK	£9.95
Number Rally	Ed	Longman	B	C	LM	£9.95
Number Skills 0-20	Ed	Longman	B	C	LM	£9.95
Number Skills 0-999	Ed	Longman	B	C	LM	£9.95
Nursery Rhymes	Ed	Ega Beva	B	C	EB	£9.95
Neanderthal Man	Gm	Alligata	B	C	SY	£7.95
Negadd & Negmin	Ed	Scholar	B	C,D	SC	£7.00, £9.00
Nemesis	Gm	Micro Power	B	C	GK	£7.95
Neutron	Gm	Superior	B	C	SE	£6.95
Night Sky	Do	Bridge	B	C	BR	£9.90
Number	Ed	Edsoft	B	C,D	ES	£4.95
Numberfun	Ed	Griffin	B,E	C	GR	£9.95
Numerology	Ed	Pumpkin	A,B	C	PU	£5.00
Nuts	Ed	Creative Sparks	B	C	TE	£7.95
Odds on Geography	Ed	Dial	B	C,D	DL	£4.95, £6.50
Odds on Inventors	Ed	Dial	B	C,D	DL	£4.95, £6.50
Odds on Monarchs	Ed	Dial	B	C,D	DL	£4.95, £6.50
Odds on Musicians	Ed	Dial	B	C,D	DL	£4.95, £6.50
Odds on Writers	Ed	Dial	B	C,D	DL	£4.95, £6.50
Oblivion	Gm	Bug-BYte	B	C	BB	£7.50
Old Father Time	Gm	Bug-Byte	B	C	BB	£9.50
Oil	Gm	Computersmith	B	C	LC	£5.50
Ollie Octopus' Sketchpad	Ed	Storm	B	C,D	SX	£6.05, £9.95
Omega Probe	Gm	Optima	B	C	OP	£8.95
One to Nine	Ed	Acornsoft	B	C	AL	£9.95
Oneshot	Ut	Clares	B	D	CL	£12.00, £15.00 (3")
1-2-3 Snap	Ed	Ega Beva	B	C	EB	£11.95
Open Evening Timetable	Ed	A.J.	B	C,D	AJ	£14.95, £19.95
Optimon	Ut	Optima	B	C	OP	£9.95
Optics	Ed	Hutchinson	B	C	HN	£18.40

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SE Superior Software
69 Leeds Road
Bramhope
Leeds

SF Softspot
29 South Crescent
Prittlewell
Southend
Essex SS2 6TB

SH Shards Software
189 Eton Road
Ilford
Essex IG1 2UQ

SH Shumwari Associates
12 Marlin Court
Marlow SL7 2AJ

SI Scisoft
5 Minster Gardens
Newthorpe
Eastwood
Notts. NG16 2AT

SI Simonsoft
25 Tatham Road
Abingdon
Oxon OX14 1QB

SJ S.J. Grist
127 Waxwell Lane
Pinner
Middlesex

SK Skywave Software
73 Curzon Road
Boscombe
Bournmouth BH1 4PW

SL Silverlind Ltd
156 Newton Rd.,
Burton-on-Trent
Staffordshire DE15 OTR

SM Small School Software
41 Sinah Lane
Hayling Island
Hampshire
PO11 0HJ

SN Soft Centre
Renryle Cottage
Okehurst Lane
Billinghurst
West Sussex RH14 9HR

SO Solar Soft
5 Westmorland Drive
Camberley
Surrey GU15 1EW

SP Sapphire Software
Box 67
Wakefield
Yorkshire

SQ Square Software
12a Uplands Terrace
Swansea
W Glamorgan

SR Starsoft
9 Chatsworth Road
Worsley
Manchester
M28 4NU

SS Squirrel Software
4 Bindloss Avenue
Eccles
Manchester M30 0DV

ST Stell Software
36 Limefield Ave
Whalley
Lancs BB6 9RJ

SU John Wiley and Sons Ltd
Distribution Centre
Shripney Road
Bognor Regis
West Sussex PO22 9SA

SV Silversoft
London House
271-273 King St.
London W6 9LZ

SW Software Projects
Bear Brand Complex
Allerton Road
Woolton
Liverpool
Merseyside L25 7SF

SX Storm
Winchester House
Wootton Grove
Sherborne
Dorset

SY System Software
12 Collegiate Crescent
Sheffield S10 2BA

TE Technical Education
112 City Road
London EC1

TH Thor
Erskine Industrial Estate
Liverpool
Merseyside L6 1AP

TS 3SL Computers
Brook House
513 Crewe Road:Wheelock,
Sandbach
Cheshire CW11 0QX

UP Cambridge University Press
Edinburgh Building
Shaftesbury Road
Cambridge

VA Vampyre Software
PO Box MT15
Shadwell
Leeds LS17 8DW

VC Vulcan Computing
32 Guildford Road
32 Guildford Road
Farnham
Surrey GU9 9QB

VI Visions Software
1 Felgate Mews
Studland Street
London W6

VG Virgin Games
61/63 Portobello Road
London W11 3DD

VN Vine Micros
Marshborough
Sandwich
Kent CT13 0PG

WI 5 Belmont Avenue
Edmonton
London N9 7JL

YH Yorke House Software
33 West Street
Oundle
Peterborough
PE8 4EJ

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SOFTWARE LISTINGS

Title	Type	Manufacturers	Memory		Software Supplier	Price
Options	Ed	System	B	C	SY	£23.00
Options Timetable	Ed	A.J.	B	C,D	AJ	£14.95, £19.95
Order Processing	Bs	Acornsoft	B	D	AL	£24.95
O.S. Quiz	Ed	Arnold-Wheaton	B	C	AW	£6.00 + VAT
Oscilloscope	Ed	RJE Software	B	C	RJ	£6.95
Othello	Gm	Computer Concepts	A,B,E	C	GJ	£8.95
Othello	Gm	Computercat	B	C	CC	£8.95
Othello	Gm	Sapphire	B	C	SH	£5.95
Paintbox	Ut	Beebug	B	C,D	BE	£10.00, £12.00
Paintbox	Do	Oakleaf	B	C	OA	£9.95
Painter	Gm	A & F	B	C	GE	£8.00
Painting	Ut	BBC	A,B	C	JB	£6.0
Paras	Gm	Lothlorien	B	C	LO	£6.95
Pareto Analysis	B	Micropax	B	C	MP	£7.95
Parity	Ed	N. Darwood	A,B	C	JB	£10.00
Parts of a Sentence	Ed	Scholar	B	C,D	SC	£5.00, £7.00
Pascal	Ed	Chalksoft	B	C	KT	£5.95
Passit Transformations	Ed	Edsoft	B	C	ES	£5.95
Password	Ed	MP	B	C,D	MP	£11.00, £14.00
Past to Present	Ed	Heinemann	B	C	HE	£9.25 + VAT
Paul Daniel's Magic Show	Do	Acornsoft	B	C,D	AL	£9.95, £11.50
Payroll	Bs	Micro-Aid	B	C	IZ	£17.95
Peeko Computer	Bs	Acornsoft	A,B	C	AL	£9.95, £9.20
Peggit	ED	Ed. Soft	B	C	ES	£5.95
Password	Ed	MP Software	B	C,D	MP	£11.00, £14.00
Pengwyn	Gm	Postern	B	C	PT	£6.95
Pansion	Bs	Micro-Aid	B	C	IZ	£4.95
Pentiles	Ed	Silverlind	B	C	SL	£6.95
Percentages	Ed	Scholar	B	C,D	SC	£5.00, £7.00
Percy Penguin	Gm	Superior	B,E	C	SE	£7.95
Perseus and Andromeda	Gm	Digital Fantasia	B	C	NT	£10.29
Personal Accounts	Do	Kansas	B	C	KA	£10.50
Personal Money Management	Do	Acornsoft	B,E	C	AL	£11.90, £11.50
Pettigrews Diary	Gm	Shards	B,E	C	SH	£7.95
Pharoah's Tomb	Gm	A&F Software	B	C	GE	£8.00
Philosopher's Quest	Gm	Acornsoft	B	C	GA	£9.95
Physics	Ed	Micro Power	A,B,E	C	GK	£6.95
Picture Maths	Ed	A J Visions	B	C	AV	£9.95
Picfile	Ed	Cambridge Micro	B	C,D	CM	£20.08
Picture Builder	Ed	Hill MacGibbon	B	C	HM	£9.95
Picture Puzzles	Ed	LCL	A,B,E,	C	LA	£6.50
Picture Book	Ed	LTS	B	D	LT	£14.95
Picture Spell	Ed	GED Software	B	C	GD	£5.00
Pieman	Gm	Musicsoft	B	C	MS	£3.75
Pinball	Gm	Microbyte	B	C	MB	£5.95
Perspective	Ut	Aztec	B	C	AZ	£6.50
Picasso GS	Ut	Odyssey	B	C	OG	£4.50
Picsave	Ut	Hexagon S/W	A,B	C	JA	£6.00
Pick-a-Word	Ed	Ega Beva	B	C	EB	£11.95
Picture Book	Ed	LTS	B	D	LT	£14.95
Picture Maker	Ut	Acornsoft	B,E	C	AL	£9.95, £9.20
Picture Maths	Ed	A.J.	B	C,D	AJ	£9.95, £12.95
Picture Puzzles	Gm	Ludinski	B,E	C	KA	£6.50
Pirate Adventure	Gm	Adventure International	B,E	C	AI	£7.95
Pirate	Ed	Chalksoft	B	C	CH	£9.25
Planes	Gm	A&F	B	C	GE	£8.00
Planetarium	Ed	Superior	B	C	SE	£7.95
Planet Invaders	Gm	Merlin	B	C	MN	£7.95
Planetfall	Gm	ASP Software	B,E	C	AS	£11.45
Planet of Colourful Sound	Ed	Honeyfold	B	C,D	HO	£9.95, £11.95
Planetoid	Gm	Acornsoft	B	C	AL	£9.95
Playbox	Gm	Comsoft	B,E	C,D	CM	£6.50, £8.50
Play With Words	Ed	Pee Bee	B	C,D	PB	£8.50, £11.00
Plegaron People Eaters	Gm	R. H. Electronics	B	C	RH	£8.95
Plotter	Ed	Dial	B	C,D	DL	£6.50, £8.00
Plunder	Gm	Cases	B	C	CE	£6.95
Podd	Ed	ASK/Acornsoft	B,E	C,D	AL	£9.95, £11.50
Population Growth	Ed	C.U.P.	B	C	CP	£13.95
Poker Dice	Gm	Micro Power	B	C	GK	£5.95
Powerboat Race	Gm	Futura S/W	B	C	JC	£7.95
Polar Traveller	Ed	Trekkasoft	B	C,D	TR	£5.50
Polaris	Gm	Bug Byte	B	C	KP	£5.50
Polygon Tutor	Ed	Pee Bee	B	C,D	PB	£7.50, £10.00
Pontoon	Gm	M and M Software	B	C	M	£5
Pool	Gm	Dynabyte	B,E	C	DB	£7.95
Population Growth	Ed	Cambridge Micro	B	C,D	CM	£13.95 + £1.62
Position	Gm	Micro Power	B,E	C	GK	£6.95
Procaid	Ut	Micro Aid	A,B	C	IZ	£3.45
Procflush	Ut	Micro-Aid	A,B	C	IZ	£1.00
Procvar	Ut	Micro-Aid	A,B	C	IZ	£1.95
Process Capability	Bs	B J Software	B	C	BJ	£8.00
Proteanse	Gm	D.K. Tronics	B	C	DK	£6.95
Primary Art	Ed	Alligata	B,E	C	SY	£7.95
Primary Time	Ed	Alligata	B,E	C	SY	£7.95
Princess	Gm	Aztec S/W	A,B	C	IB	£6.50
Printer Driver Generator	Ut	Acornsoft	B	C,D	AL	£9.95, £11.50
Process Capability	Bs	B J Software	B	C	BJ	£8.00
Project Planner	Bs	Triptych	B	C,D	TP	£19.95, £24.95
Progo	Ed	Edsoft	B	C,D	ES	£8.95, £10.50
Protractor Tutor	Ed	Pee Bee	B	C,D	PB	£7.80, £10.30
Pub games/Picasso package	Gm	Starsoft	B	C	SR	£9.95
Punc-Man	Ed	Chalksoft	B	C	KT	£7.95
Punction/Word Finder	Ed	Heinemann	B	C	HE	£9.25 + VAT
Punctuation	Ed	Bryants S/W	B	C	HW	£4.88
Purchasing	Bs	Acornsoft	B	D	AC	£24.95
Putting Numbers In Order	Ed	Scholar	B	C,D	SC	£7.00, £9.00
Pyramid	Ed	Highlight	B	C,D	HI	£6.00, £7.00
Pyramid of Doom	Gm	Adventure International	B,E	C	AI	£7.95
Pyramid Painter	Gm	Thor	B	C	TH	£5.95
Questionmaster	Ed	Hutchinson	B	C	HN	£28.75
Q Bert	Gm	Superior Software	B	C	SE	£7.95
Quick Thinking!	Ed	Mirror	B,E	C	MR	£6.95
Railroader	Ed	Stell	B	C	ST	£7.95
Rally A/B	Ed	Longman	B	C,D	LM	£9.95, £12.95
Record Changer	Do	A.J.	B	C,D	AJ	£19.95, £24.95
Record Keeper	Ut	BBC Pubs	B	C	KB	£13.80
Recover	Ut	Baksoft	A,B	C	BK	£6.00
Readability	Ed	Arnold-Wheaton	B	C	AW	£6.00 + VAT
Readability	Ed	GSN	B	C,D	GS	£8.00, £9.00
Return to Eden	Gm	Level 9	B	C,D	CU	£9.95, £11.95
Report	Ed	GSN	B	D	GS	£38.50
Revenge of Zopr	Gm	Kansas	B	C	KA	£9.50
Reversi	Gm	Microbyte	B	C	MB	£5.95
Reversi	Gm	Superior Software	B,E	C	SE	£6.95
Reversi	Gm	Kansas	B	C	KA	£6.25
Reversi	Gm	Silverlind	B	C	SL	£6.95
Reversi 1	Gm	Micro Power	A,B	C	GK	£5.95

Reversi 2	Gm	Micro Power	B	C	GK	£5.95
Ripple Tank	Ed	RJE Software	B	C	RJ	£7.95
River Adventure	Ed	Pee Bee	B	C,D	PB	£9.50, £12.00
Riverworld Adventure	Gm	O.K.	B	C	OK	£10.00
Road Racer	Gm	Superior Software	B	C	SE	£7.95
Road Runner	Gm	Superior Software	B	C	CH	£7.95
Road Safety	Ed	Bryants	A,B	C	HW	£4.85
Robotic Sums	Ed	GED Software	B	C	GD	£4.50
Robot	Gm	Miking S/W	B	C	KC	£4.95
Rocket Raid	Gm	Acornsoft	B	C	AL	£9.95
Rocky	Gm	Superior	B	C	SE	£7.95
ROM Read	Ut	A.J.	B	C,D	AJ	£8.95, £11.95
Roman Empire	Gm	Lothlorien	B	C	LO	£6.95
Romeo and Juliet	Ed	Penguin	B,E	C	PE	£5.95
Roulette	Gm	Micro Power	A,B	C	GK	£5.95
Row of Four	Gm	Software For All	B	C	KN	£6.95
Royalty Quiz	Do	Acornsoft	B	C	AL	£12.65
Rubble Trouble	Gm	Micro Power	B	C	GK	£7.95
Run Rabbit Run	Ed	Hill MacGibbon	B	C	HM	£6.95
Russian Irregular Verbs	Ed	Carsondale	B	C	CD	£21.00
Russian Text Fill	Ed	Carsondale	B	C	CD	£11.96
SAS Commander	Gm	Comsoft	B,E	C	CM	£4.95
Savage Island 1/2	Gm	Adventure International	B,E	C	AI	£7.95
Savage Pond	Gm	Starcade	B	C,D	SC	£8.95
Scales and Decimal Estimation	Ed	RJE Software	B	C	RJ	£3.95
Scanning/Word Finder	Ed	Heinemann	B	C	HE	£9.25 + VAT
School Text	Ed	GSN	B	C,D	GS	£14.00, £15.00
Science 1	Ed	Shards	B,E	C,D	SH	£6.95, £9.95
Science Pack	Ed	Dial	B	C,D	DL	£4.95, £6.50
Science Fiction Quiz	Do	Acornsoft	B,E	C	AL	£12.65
Sets and Operators	Ed	Shiva	B	C	SV	£14.95
737 Simulator Flight	Gm	Salamander	B,E.	C	SA	£9.95
Scramble	Gm	Bug-Byte	A,B	C	BB	£6.95
Scred	Bs	Stable	B	C	CS	£18
Scribe	Bs	Merlin	B	C	MN	£29.95
Scribe II	Do	Alligata	B,E	C,D	SY	£9.95, £14.95
Sea Cliff Erosion	Ed	Cambridge Micro	B	C,D	CM	£15.00 + VAT
Sea Lord	Gm	Bug-Byte	B	C	BB	£7.50
Sea Wolf	Gm	Optima	B	C	OP	£8.95
Search for the Jewels	Gm	SJG Soft	B	C	SJ	£8.95
Searchbas	Ut	Micro-Aid	A,B	C	IZ	£1.95
Secret Mission	Gm	Adventure International	B,E	C	AI	£7.95
Seed Germination	Ed	Garland Comp.	B	C	JX	£18.82
Seige	Gm	Postern	B	C	PT	£6.95
Sentence Maker	Ed	Arnold-Wheaton	B	C	AW	£9.95 + VAT
Sequences	Ed	Chalksoft	B	C	CH	£5.95
737 Flight Simulator	Gm	Salamander	B,E	C	SA	£9.95
Shirley Conran's Magic Garden	Do	Acornsoft	B	C	AL	£9.95
Sheepdog	Ed	Longman	B	C	LM	£9.95, £12.95
Sheepdog Trials	Ed	Bryants S/W	B	C	HW	£4.80
Share Analyser	BS	Synergy	B,E	C,D	SY	£14.95, £19.95
Shoot/Top Shot	Ed	Soft Centre	B	C	SN	£6.00
Shootout	Gm	MP S/W	B	C	JZ	£5.00
Seek	Gm	Micro Power	A,B	C	GK	£6.95
Sentence Sequencing	Ed	Acornsoft	A,B	C	AL	£11.90
Sentence Shaker	Ed	GED Software	B	C	GD	£4.50
747	Gm	Doctor Soft	B	C	DO	£7.95
747	Gm	D.A.C.C.	B	C	DC	£9.95
Shadowfax	Gm	Postern	B	C	PT	£6.95
Shape Generator	Ut	Software for All	B	C	KN	£11.50
Shapes Package	Ed	GED Software	B	C	GD	£8.00
Shape Snap	Ed	Ega Beva	B	C	EB	£11.95
Shop Keeper	Ed	Heinemann	B	C	HE	£9.25 + VAT
Shopping	Ed	GED Software	B	C	GD	£4.50
Shrinking Professor	Gm	A&F	B	C	GE	£8.00
Shuttle	Gm	Molimerx	B	C	MX	£14.95
Shuttle Pilot	Gm	Oakleaf	B	C	OA	£9.95
Signals & Magic	Ed	HRH	B	C,D	HH	£4.80, £6.10
Signs	Ed	Acornsoft	A,B	C	AL	£11.90
Silversoft Index	Do/Bs	Silversoft	B	D	SV	£24.99
Simonsoft Sprites 2	Ut	Simonsoft	B,E	C,D	SI	£12.95
Simple Word Processor	Do	A.J.	B	C,D	AJ	£9.95, £14.95
Simple Queues	BS	Micropax	B	C	MP	£7.95
Simulation Surgery	BS	Micropax	B	C	MP	£12.95
Simulation-Carlton Trucks	Bs	Micropax	B	C	UP	£12.95
Sinbad	Gm	Virgin	B	C	VG	£7.95
6502 Development System	Ut	Acornsoft	B	D	AL	£49.85
Sixers	Gm	O.I.C.	B,E	C	OI	£6.95
Skwosh	Gm	Miking S/W	B	C	KC	£3.95
Sliding Block Puzzles	Gm	Acornsoft	B	C	AL	£9.95
Sliding Block Puzzle	Ed	Ega Beva	B	C	RB	£9.95
Ski Slalom	Gm	R.H. Electronics	B	C	RH	£8.95
Sir Francis Drake Adventure	Ed	LCL	B,E	C	LA	£6.50
Slicker Puzzle	Gm	G.K. Tronics	B	C	DK	£6.95
Snail Trail	Gm	R.H. Electronics	B	C	RH	£4.95
Snake	Gm	Kansas	B	C	KA	£8.50
Snake	Gm	Computer Concepts	B	C	GJ	£6.67
Snake Pit	Gm	Postern	B	C	PT	£6.95
Snapper	Gm	Acornsoft	B,E	C,R	AL	£9.95, £9.20
Snig	Gm	Computercat	B	C	CC	£6.75
Snooker	Gm	Visions	B	C	VI	£8.95
Snooker	Gm	Acornsoft	B	C	AL	£9.95
Snorter	Gm	Beebug	B	C	BE	£7.50
Snowball	Gm	Level 9	B	C	CU	£9.90
Son of Blagger	Gm	Alligata	B	C	AG	£7.95
Sorcerer of Claymorgue	Gm	Adventure International	B,E	C	AI	£7.95
Sort Animator	Ed	OIC	B	C	OI	£6.50
Sort M/C	Ut	Micro-Aid	A,B	C	IZ	£1.00
Sortbas	Ut	Micro-Aid	A,B	C	IZ	£1.00
Sortout	Ed	Highlight	B	C,D	HI	£6.00, £7.00
Spacehawks	Gm	Computer Concepts	B	C	GJ	£7.80
Space Adventure	Gm	Virgin Games	B	C	VG	£7.95
Space Adventure	Ed	LTS	B	C,D	LT	£11.95
Space Cab	Gm	Kansas	B	C	KA	£7.25
Space Fighter	Gm	Superior Software	B	C	SE	£7.95
Space Invaders	Gm	Bug-Byte	B	C	BB	£5.50
Space Pirates	Gm	Bug-Byte	A,B	C	BB	£5.50
S-Pascal	Ut	Acornsoft	B	C,D	AL	£16.85, £19.90
Spacex	Ed	4MAT	B	CD	FM	£8.65, £10.40
Spaceguard	Gm	MP Software	B	C	MP	£6.50
Space Hi-way	Gm	Amcom	B	C	AO	£7.45
Space Kingdom	Gm	Software For All	B	C	KN	£7.95
Space Maze	Gm	Micro Power	B	C	GK	£7.95
Spacefight	Gm	Miking S/W	B	C	KC	£7.95
Space Warp	Gm	Bug Byte	B	C	BB	£11.50
Space Fighter	Gm	MP S/W	B	C	JZ	£8.50
Space Fighter	Gm	Superior S/W	B	C	KH	£7.00
Space Games Pack 1	Gm	Futura S/W	A,B	C	JC	£3.99
Space Games Pack 2	Gm	Futura S/W	A,B	C	JC	£3.99
Space Games Pack 3	Gm	Futura S/W	A,B	C	JC	£4.99
Space Games Pack 4	Gm	Futura S/W	A,B	C	JC	£4.99
Space Station Alpha	Gm	Icon	B,E	C	IO	£6.95
Space Jailer	Gm	Micro Power	B	C	GK	£6.95
Space Journey	Ed	Honeyfold	B,E	C,D	HO	£9.95, £11.95
Space Ranger	Gm	Microbyte	B	C	MB	£7.95
Space Station Alpha	Gm	Icon	B,E	C	IO	£7.95
Spaceman Sid	Gm	English Software	B,E	C	EN	£7.95
Space Trek	Gm	Program Direct	B	C	NP	£5.99
Space Pirates	Gm	Bug Byte	A,B	C	KP	£8.00
Spanish Tutor A/B	Ed	Kosmos	B,E	C	KM	£9.95
Special Agent	Ed	Heinemann	B	C	HE	£9.25 + VAT
Speechparts	Ed	Bryants S/W	B	C	HW	£4.88
Speed and Light	Ed	Acornsoft	A,B	C	AL	£11.90
Spellbound (lrg/hrg)	Ed	GSN	B	C,D	GS	£14.00, £15.00
Spellcheck (Wordwise)	Ut	Beebug	B	D	BE	£19.00
Spellcheck	Ed	Edsoft	B	C,D	ES	£4.95
Spelling	Ed	Soft Centre	B	C	SN	£6.00
Spell 7 + /9 +	Ed	Primary	B	C.D	PP	£5.95, £7.95

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SOFTWARE LISTINGS

Title	Type	Manufacturers	Memory		Software Supplier	Price
Spelltest	Ed	Bryants	A,B	C	HW	£4.85
Spellings	Ed	ECL	B	C	EL	£5.99
Spiderman	Gm	Adventure International	B,E	C	AI	£7.95
Spitfire Command	Gm	Superior	B	C	SE	£7.95
Spitfire Flight Simulator	Gm	Alligata	B	C	SY	£7.95
Sphinx Adventure	Gm	Acornsoft	B,E	C	AL	£9.95, £9.20
Splashdown	Ed	Highlight	B	C,D	HI	£6.00, £7.00
Sploosh	Ed	Highlight	B	C,D	HI	£6.00, £7.00
Spreadsheet	Ed	Contex	B	C	CX	£7.99
Sprites	Ut	Beebug	B	C,D	BE	£10.00, £12.00
Spy	Ut	System	B	C	SY	£24.15
Squash	Ut	Pica	B	C,D	PI	£9.75, £11.95
Squash	Gm	Aztec S/W	A,B	C	IB	£5.50
Squeeze	Ed	ASK/Acornsoft	B,E	C,D	AL	£9.95, £11.50
Staircase Stampede	Gm	Comsoft	B	C,D	CM	£7.50, £9.50
Standards and Variances	Bs	Micropax	B	C	MP	£7.95
Starbattle	Gm	Kudusoft	B	C	KU	£5.50
Star Battle	Gm	Superior	B	C	SE	£7.95
Star Gazer	Ed	Heinemann	B	C	HE	£9.25 + VAT
Starlander	Gm	Kudusoft	A,B	C	KU	£3.50
Star Patrol	Gm	Kudusoft	B	C	KU	£6.50
Starship Command	Gm	Acornsoft	B,E	C,R	AL	£9.95, £9.20
Star Seeker	Do	Mirrorsoft	B	C,D	MR	£9.95, £12.95
Star Trader	Gm	FBC Systems	B	C	FB	£9.50
Star Striker	Gm	Superior	B	C	SE	£7.95
Starfighter	Gm	FBC Systems	B	C	FB	£7.50
Star Trek Adventure	Gm	Superior Software	B	C	SE	£7.95
Star Trek	Gm	Micro Power	A,B	C	GK	£5.95
Star Maze	Gm	Database Software	B	C	NU	£7.50
Star Patrol	Gm	Kudusoft	B	C	KU	£6.50
Startrek/Candy Floss	Gm	I.J.K.S/W	A,B	C	IT	£5.95
Star Trek	Gm	Hexagon S/W	A,B	C	JA	£5.50
Starpack	Ed	Micro-Aid	B	C	IZ	£9.95
Starter Word Splits	Ed	Sulis	B	C	SU	£9.95
Stats 1	Bs	ME & P Products	A,B	C	KK	£15.00
Statistics 1/2	Ed	Chaddington	B,E	C,D	CN	£10.00
Stock	Ed	System	B	C,D	SY	£14.95
Stock Car	Gm	Micro Power	B	C	GK	£7.95
Stock Control	Bs	Acornsoft	B	D	AL	£24.95
Stock Control	Bs	Gemini	B	C	GM	£19.95
Stock Control, classification	BS	Micropax	B	C	MP	£7.95
Stock Control-EOQ	BS	Micropax	B	C	MP	£7.95
Stock Control-Roq and Rol	Bs	Micropax	B	C	MP	£7.95
Stockmarket	Gm	Micro-Aid	B	C	IZ	£4.95
Stockmarket	Gm	ASP Software	B,E	C	AS	£6.99
Story	Ed	HRH	B	C,D	HH	£5.65, £6.95
Story A — Spanish Gold	Ed	Chalksoft	B	C	CH	£7.95
Storybuilder	Ed	Bryants S/W	B	C	HW	£4.85
Stock Valuation	Bs	Micropax	B	C	MP	£7.95
Story	Ed	H&H	B (40/80)	C,D	HH	£7.50, £9.50, £10.50
Stranded	Gm	Superior	B,E	C	SE	£7.95
Strange Odyssey	Gm	Adventure International	B,E	C	AI	£7.95
Stunt Flyer	Gm	Phoenix Software	B	C	PH	£6.99
Subkiller	Gm	D.K. Tronics	B	C	DK	£6.95
Submarines	Ed	GED Software	B	C	GD	£4.00
Suffixes	Ed	Golem	B	C	OB	£8.05
Sum Fun	Ed	GSN	B	C	GS	£8.00, £9.00
Summit (hrg/lrg)	Ed	GSN	B	C,D	GS	£8.50, £9.50
Super Fruit	Gm	Simonsoft	B,E	C,D	SI	£5.95
Super Fruits	Gm	D.K. Tronics	B	C	DK	£6.95
Super Invaders	Gm	Acornsoft	B	C	AL	£9.95
Superlife	Ed	Golem	B,E	CD	OB	£4.95, £6.95
Supersquare	Ed	GSN	B	C,D	GS	£8.50, £9.50
Superplot	Ut	Beebug	B	C	BE	£10.00
Super Spell	Ed	Aztec	A,B	C	AZ	£5.50
Supergolf	Gm	Squirrel Softwre	B	C	SS	£7.50
Super Hangman	Gm	I.J.K. S/W	B	C	IT	£3.95
Survival	Ed	System	B	C	SY	£14.95
Survivor	Gm	MP Software	B,E	C,D	MP	£7.48, £10.50
Swag	Gm	Micro Power	B,E	C,D	GK	£6.95
Swamp Monsters	Gm	M P Software	B	C	JZ	£6.50
Swamp Monsters	Gm	M P Software	B	C	JZ	£6.50
Swordmaster	Gm	Micrograf	B,E	C,D	MF	£7.95, £10.95
Tables Test	Ed	Bryants S/W	B	C	HW	£4.88
Tables	Ed	Bryants	A,B	C	HW	£4.85
Tables	Ed	ECL	B	C	EL	£5.99
Table Sums	Ed	Griffin	B	C	GR	£9.95
Table Adventures	Ed	A.S.K	B	C	AK	£9.95
Tables Wizard	Ed	Hill MacGibbon	B	C	HM	£6.95
Take It Away	Ed	Arnold-Wheaton	B	C	AW	£6.00 + VAT
Talkback	Ed	Acornsoft	E,B	C,D	AL	£9.95, £11.50
Tank Attack	Gm	Gem Software	B	C	GC	£7.95
Tanks	Gm	Salamandar	B	C	SA	£7.95
Tape Catalogue	Ut	A.J.	B	C	AJ	£5.95
Tape Copy	Ut	Davansoft	A,B	C	NX	£7.50
Tarzan	Gm	Alligata	B	C	AG	£7.95
Taxcalc	Ut	BBC Pubs	B	C	KB	£17.25
Teacher in the Custard	Ed	Pee Bee	B	C,D	PB	£8.50, £11.00
Teacher's Toolkit	Ed	Wida Software	B	C	FY	£30.00
Teletext Pack	Ut	Beebug	B	C,D	BE	£10.00, £12.00



Temperature Control Simulation	Ed	Acornsoft	B	C,D	AL	£9.95, £11.50
Ten Little Indians	Gm	Digital Fantasia	B	C	NT	£10.29
Tense French	Ed	Sulis	B	C	SU	£9.95
Tessalations	Ed	Cambridge Micro	B	D	CM	£25.00 + VAT
Tess	Ed	HRH	B	C,D	HH	£6.55, £7.85
Tesselator	Ut	Addison-Wesley	B	C	AN	£21.95 + VAT
Test Match	Gm	CRL	B	C	CO	£7.95
Tetrapod	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Text Grader	Ed	Hutchinson	B	C	HN	£28.75
Text Print Extension	Ut	Ratco Soft	A,B	C	RA	£2.00
Text Processing Pack	Bs	Eduquest	B	C	NW	£10.00
Theatre Quiz	Do	Acornsoft	B,E	C	AL	£12.65
The Animator	Ut	Screenplay	B	C	SC	£11.95
The Count	Gm	Adventure International	B,E	C	AI	£7.95
The Complete Cocktail Maker	Do	Acornsoft	B	C,D	AL	£9.95, £11.50
The Horse Lord	Gm	Century	B	C	CY	£7.95, £12.95 + book
The Hulk	Gm	Adventure International	B,E	C	AI	£7.95
The Mystery Fun House	Gm	Adventure International	B,E	C	AI	£7.95
The Seventh Star	Gm	Acornsoft	B	C	AL	£9.95
The Frog	Gm	James Hager	B	C	IV	£6.50
The Golden Baton	Gm	Digital Fantasia	A,B	C	NT	£8.95
3-D Mouse Maze	Gm	Rainbow S/W	B	C	KS	£3.50
3-D Maze	Gm	Hexagon S/W	A,B	C	JA	£6.00
3D Maze	Gm	Earthshock S/W	A,B	L	KI	£3.00
3D Maze	Gm	I.J.K. S/W	B	C	IT	£3.95
The Alien Planet	Ed	Honeyfold	B,E	C,D	HO	£9.95, £11.95
The Basic Lesson	Ed	Ega Beva	B	C	EB	£11.95
The Bunsen	Ed	Scholar	B	C,D	SC	£6.00, £8.00
The Computer Programme Programs Vol 2	Do	B.B.C	B	C	KB	£10.00
The Computer Programme Programs Vol 1	Do	B.B.C.	A,B	C	KB	£10.00
The Golden Baton	Gm	Digital Fantasia	A,B	C	NT	£10.29
The Graphics Lesson	Ed	Ega Beva	B	C	EB	£11.95
The Generators	Gm	Quicksilva	B	C	QS	£6.95
The Halls of Time	Gm	OK	B	C	OK	£10.00
The Lemming Syndrome	Gm	Dynabyte	B,E	C	DB	£7.95
The Frog	Gm	Software For All	B	C	KN	£7.95
The Guns of Navarone	Gm	D.A.C.C.	B	C	DC	£7.95
The Mine	Gm	Micro Power	B	C	GK	£7.95
The Theorem of Pythagoras	Ed	Small School	B	C	SM	£6.95
The Ring of Time	Gm	Kansas	B	C	KA	£9.50
The Typing Master	Do	Anthony Ashpitel	B	C	AA	£20.00
The Wizard of Akyrz	Gm	Digital Fantasia	B	C	NT	£10.29
The Garden	Ed	Clares	A,B	C	CL	£6.95
The Time Machine	Gm	Digital Fantasia	A,B	C	NT	£8.95
There	Ed	Golem	B	C	OB	£8.05
3-Deep Space	Gm	Postern	B	C	PT	£7.95
3D-Tankzone	Gm	Dynabyte	B	C	DB	£8.95
Time	Ed	Stell	B,E	C,D	ST	£7.95
Timeman Two	Ed	Bourne	B,E	C	BO	£8.97, £10.98
Timeman One	Ed	Bourne	B,E	C,D	B	£8.97, £10.98
Time Series Analysis	Bs	Micropax	B	C	MP	£7.05
Timetable Clock	Ed	Primary	B	C,D	PP	£5.95, £7.95
Timetabling OPT 1-6	Ed	Hutchinson	B	C	HN	£17.25
Timetabling TT 1-6	Ed	Hutchinson	B	C	HN	£17.25
Time Traveller	Ed	Sulis	B	C	SU	£9.95
Timetrek	Gm	Micro Power	B,E	C	GK	£6.95
Tiny Pascal	Ut	H.C.C.S.	A,B	R	HC	£59.00
Titrations	Ed	System	B	C	SY	£14.95
Tomb Adventurer	Ed	Heinemann	B	C	HE	£9.25 + VAT
Thombs of Arkenstone	Ed	Arnold-Wheaton	B	C	AW	£15.00 + VAT
Tom Thumb Adventure	Gm	OK	B	C	OK	£10.00
Toolbox	Ut	BBC Pubs	B	C	KB	£21.00
Toolkit	Ut	Beebug	B	R	BE	£27.00
Toolstar	Ut	PACE	B	R	PA	£34.00
Touch Typist	Ed	Computercat	B	C	CC	£9.95
Touch Type Tutor	Ed	Technical Education	A,B	C	TE	£4.95
Towering Inferno	Ed	Sulis	B	C	SU	£9.95
Tower of Alos	Gm	A&F Software	A,B	C	GE	£6.90
Towers	Ed	Bryants	A,B	C	HW	£4.85
Town Planner	Ed	Heinemann	B	C	HE	£9.25 + VAT
Towns of Britain	Ed	Aztec S/W	A,B	C	IB	£6.50
Towntest	Ed	Silverlind	B	C	SL	£6.50
3-D Ice Hockey	Gm	Computersmith	B	C	LC	£5.50
3 in 1	Gm	R. H. Electronics	A,B	C	RH	£7.50
Trafalgar	Gm	Squirrel Software	B	C	SS	£8.00
2002	Gm	Superior Software	B	C	SE	£7.95
Trailblazer	Ed	Arnold-Wheaton	B	C	AW	£12.95 + VAT
Tramix	Gm	D. K. Tronics	B	C	DK	£6.95
Tree of Knowledge	Ed	Acornsoft	A,B,E	C	AL	£9.95
Trek	Gm	Micrograf	B,E	C,D	MF	£7.95, £10.95
Transistors Revenge	Gm	Soft Spot	B	C	SF	£6.95
Triangles/Shapes	Ed	Primary	B	C,D	PP	£5.95, £7.95
Tripute	Gm	Dial	B	C,D	DL	£4.95, £6.50
Triangle Tutor	Ed	Pee Bee	B	C,D	PB	£6.50, £9.00
T-Squared Timetabling	Ed	Yorke House	B	D	YH	£25.00
Turbo Compiler	Ut	Salamander	B	C	SA	£9.95
Turtle Graphics	Ed	Acornsoft	B	C,D	AL	£9.95, £11.50
Twelfth Night	Ed	Penguin	B,E	C	PE	£5.95
Twenty Crosswords	Gm	NEC	B	C	NC	£6.90
Twin Kingdom Valley	Gm	Bug-Byte	B,E	C	BB	£9.50
Type Easy	Ed	Carswell	B	C	CR	£8.95
Type Invaders	Ed	Carswell	B	C	CR	£6.95
Typing Tutor	Ed	Contex	B	C	CX	£9.99
Ultima-File	Dm	Ixion	A,B	C	IN	£7.50
Ultracale	Bs	BBC Publications	B	R	KB	£74.95
Understanding Your Weather	Ed	Heinemann	B	C	HE	£9.25 + VAT
Unimo	Gm	Dial	B	C,D	DL	£3.95, £5.50
Utilities Package	Ut	Salamander	B	C	SA	£9.95
Unoriginal Games	Gm	McKeran	A,B	C	MK	£2.00
Unorthodox Engineers	Gm	Mosaic	B	C	MD	£9.95
Util-1	Ut	Gem Software	B	C	GC	£9.95
Utility EPROM	Ut	A.J.	B	R	AJ	£19.95
Utility Pack	Ut	Computersmith	B	C	LC	£5.50
Utilities	Ut	Qualitysoft	A,B	C	QT	£4.00
Utilities	Ut	ASD Ltd	B	C	AS	£5.75
Utilities	Ut	Golem	A,B,E	CD	OB	£5.95, £7.95
Utility A	Ut	Micro-Aid	A,B	C	IZ	£5.95
Utility Pack	Ut	Ega Beva	B	C	EB	£7.95
Vader Raid	Gm	FBC Systems	B	C	FB	£7.50
Valley	Gm	ASP Software	B,E	C	AS	£11.45
Valley of the Pharoahs	Gm	FBC Systems	B	C	FB	9.50
Varkman/Meanies	Gm	Aardvark Software	A,B	C	IU	£4.00
Vampire Castle	Gm	Micrograf	B	C,D	MF	£6.95, £9.95
VASM	Ut	Vida	B	R	VR	£35.00 + VAT
VAT Traders Ledger	Bs	Harris	B	D	HM	£21.50
Velocity of Light	Ed	GSN	B	C,D	GS	£14.00 £15.00
View Printer Drivers	Ut	Acornsoft	B	C	AI	£9.95
View Printer Driver	Ut	Alligata	B	C	SY	£7.95
Views/Faces	Ed	Primary Programs	B	C	PP	£3.95
Viewindex	Ut	Acornsoft	B	D	AL	£14.95
Viewsheet	Bs	Acornsoft	B	R	AL	£59.80
Viking England 1-4	Ed		B	C,D	FE	£45.95
Viper	Gm	R. H. Electronics	B	C	RH	£8.95
Vocab	Do	Beebug	B	C	BE	£10.00
Vogon Attack	Gm	Micromail	B	C	OE	£6.33
Volcano	Gm	Acornsoft	B	C,D	AL	£9.95, £11.50
Vortex	Gm	Software Invasion	B	C,D	IS	£7.95, £11.95

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SOFTWARE LISTING

Title	Type	Manufacturers	Memory		Software Supplier	Price
Voodoo Castle	Gm	Adventure International	B,E	C	AI	£7.95
Vu-calc	Bs	Psion	B	C	PS	£14.95
Vu-file	Bs	Psion	B	C	PS	£14.95
Vu-type	Ed	BBC Pubs	B	C	KB	£16.10
Wall	Gm	Micro Power	B	C	GK	£5.95
Watch Your Weight	Do	Acornsoft	B	C,D	AL	£9.95, £11.50
Watts in Your Home	Ed	Cambridge Micro	B	C,D	CM	£13.95 + £1.62
Weather Station	Ed	Arnold-Wheaton	B	C,D	AW	£15.00 + VAT
Web Runner	Gm	Alligata	B	C	SY	£7.95
Whatsit	Ed	Ed. Soft	B	C	ES	£4.95
What's it Worth?	Ed	Arnold-Wheaton	B	C	AW	£10.00 + VAT
What's to Eat?	Do	Shumwari	B	C,D	SH	£10.45, £13.45
Where?	ED	Primary Programs	B	C	PP	£3.95
Where?	Ed	Micro Power	B,E	C	GK	£6.95
Where...Their	Ed	Primary	B	C,D	PP	£5.95, £7.95
Which Salt?	Ed	Micro Power	B	C	OK	£6.95
White Barrows	Gm	ASP Software	B,E	C	AS	£6.99
White Knight	Gm	BBC Pubs	B	C	KB	£11.50
Whitewash	Gm	Amcom	B	C	AO	£5.95
Whole Number Arithmetic	Ed	RJE Software	B	C	RJ	£7.95
White Barrows Conquering Everest	Gm	ASP Software	A,B	C	AS	£11.45
Wilt-Spelling	Ed	Longman	B	C,D	LM	£9.95, £12.95
Wizard	Gm	Quicksilva	B	C	QS	£6.95
Wizard's Challenge	Gm	Micro Power	B	C	GK	£7.95
Wolfpack	Gm	Doctor Soft	B	C	DO	£7.95
Woodland Terror	Gm	MP	B,E	C,D	MP	£7.48, £10.50
Woodstock	BS	Micropax	B	D	MP	£29.50
Wordflash	ED	Ed. Soft	B	C	ES	£4.95
Word Fun	Ed	GSN	B	C,D	GS	£8.00, £9.00
Wordgames	Ed	Griffin	B,E	C	GR	£9.95
Word Hang	Ed	Bourne	B,E	C,D	BO	£8.97, £10.98
Word Hunt	Ed	Acornsoft	A,B	C	AL	£11.90
Wordmaster	Ed	Sulis	B	C	SU	£9.95
Word Master	Ut	R.H. Electronics	B	C	RH	£9.95
Word Mover	Do	BBC	B	C	KB	£9.95
Word Perfect	Ut	Doctor Soft	B	C	DS	£9.95
Wordpower	Ed	Sulis	B	C	SU	£9.95
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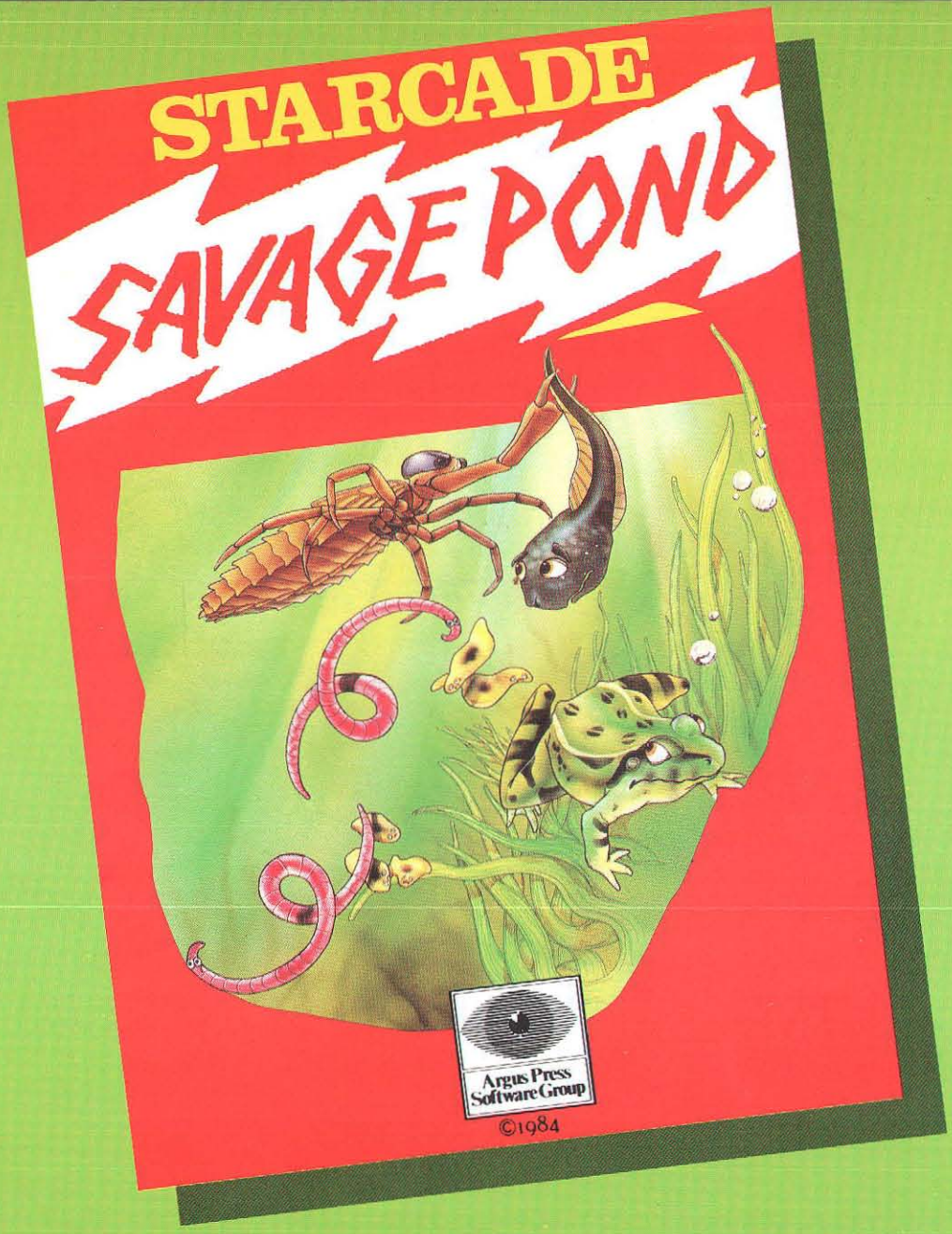
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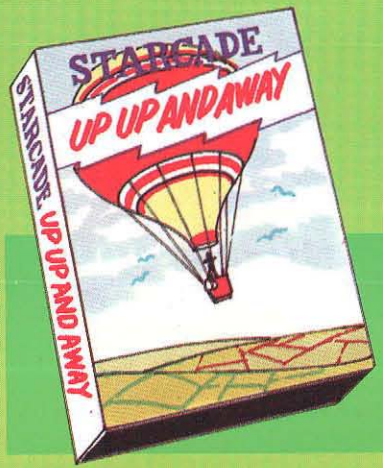
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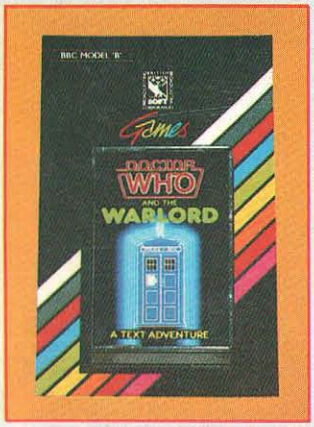
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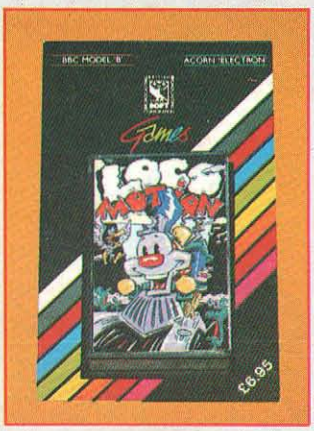
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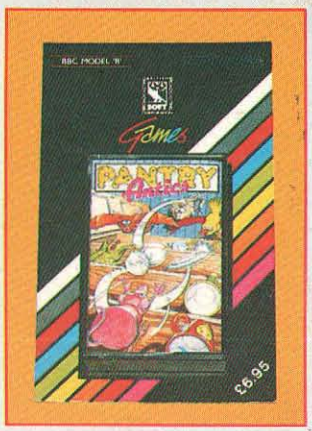
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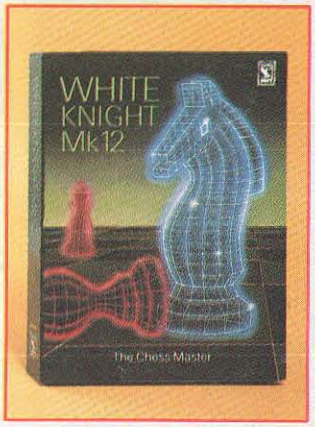
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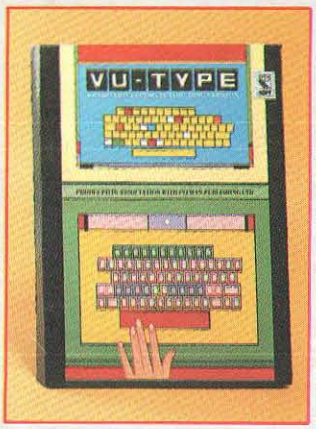


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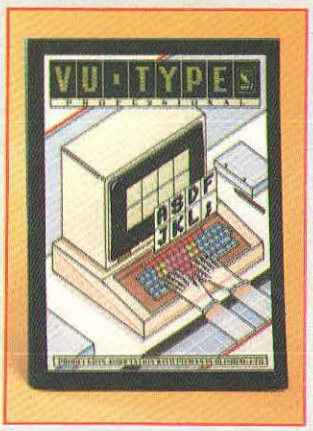


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